CHAPTER IV

ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

INTRODUCTION

This chapter provides the scientific and analytic basis for the comparison of alternatives presented in Chapter II. The narrative discusses reasons for and causes of environmental effects of the alternatives, and it presents the important interrelationships between resources, land uses, and environmental conditions.

Environmental consequences are discussed in the short- and long-term, and often by decade. Although a Forest Plan for any alternative would guide management for 10 to 15 years, effects beyond the first decade are also considered. This information helps to reveal long-term implications, and explores the potential for implementation of an alternative over time.

Like Chapter III, this chapter is organized by environmental component. The environmental consequences for each component affected by the alternatives are described in terms of direct effects, indirect effects, cumulative effects, relationships with other agencies policies or plans, and mitigation measures. Analysis of each environmental component involves some incomplete or unavailable information. A description of this information and how it was dealt with is provided.

NOTE TO READER

The following note applies to Figures which have an "NA" entry listed for Alternative NC, the No Change Altenative:

NA = Data Not Available; could not be reasonably estimated, or compared to other alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other alternatives, and could not be modeled with the current Forest FORPLAN model. Section D4b, of Chapter II in the Draft EIS describes these differences.

INCOMPLETE OR UNAVAILABLE INFORMATION

Some of the information used to predict environmental effects in this chapter is incomplete, while other information is unavailable at this time. Incomplete or unavailable information is noted later in this chapter for each major resource. The Forest has used the most current information available and state-of-the-art analytical tools to evaluate activities and to estimate effects.

The Council on Environmental Quality's NEPA regulations relating to incomplete or unavailable information have been amended (40 CFR 1502.22), amended at 51 Fed. Reg 15618 (April 25, 1986)). The following discussion complies with the amended regulations.

In the FEIS and Forest Plan:

- The discussions of the managment of the resources on the Forest have involved an evaluation of reasonably forseeable significant adverse effects on the human environment.

- The evaluation of those effects sometimes has been based upon information that is incomplete or only partially available.

- The incomplete or unavailable information cannot be obtained because the overall time and money costs to obtain the information would be exorbitant, and in many cases the means to obtain the information are not known.

Consequently, pursuant to 40 CFR 150.22(b), as amended, the following discussions of management impacts soil, water, air, vegetation, climate, fish, wildlife, artifacts and sites, recreation, scenery, Wild and Scenic rivers, Wilderness, Roadless lands, special interest areas and national natural landmarks, research natural areas and H.J. Andrews Experimental Forest, transportation system, minerals and energy, and social and economic setting include a description of the incomplete or unavailable information which is relavent to the evaluation of reasonably foreseeable significant adverse impacts associated with the alternatives.

CHANGES BETWEEN DRAFT AND FINAL

Changes were made to Chapter IV between the DEIS and this EIS in response to concerns expressed during the public comment period and as a result of newer information becoming available. The major changes are.

- The format of Chapter IV was revised to reflect major resource areas rather than programs or outputs. Specifically, discussions of effects on vegetation include timber, old growth, plant diversity, riparian, and range. Fire is discussed as it effects resouces not as a resource area.

- The discussion of old growth resources has been expanded, and the effects on existing old growth acres has been updated based on new information obtained from the Mature and Over Mature vegetation survey.

- The discussion on diversity has been expanded and is addressed in Vegetation (plant diversity) and in Wildlife (vertebrate diversity).

- Incorporated into the analysis of effects, the Regional FEIS for Managing Competing and Unwanted Vegetation.

- Updated the discussion on effects to spotted owls and spotted owl habitat to reflect the July, 1988 Supplement to the Environmental Impact Statement for an Amendment to the Pacific Northwest Regional Guide.

- The analysis of current condition and effects of the alternatives on mature and old growth forest Management Indicator Species (MIS) has been updated to reflect the impacts of forest fragmentation on habitat capability.

- The habitat requirements for primary cavity excavators have been revised based on Chapter 7, *Management of Wildlife and Fish Habitats in Forests of Western Oregon and Washington* (Brown 1985), and they are been included in the analysis of effects to potential populations.

- The habitat capability model used to predict deer and elk numbers and habitat conditions has been revised. *A Model to Evaluate Elk Habitat in Western Oregon* (Wisdom et al. 1986) was used in this FEIS. Indexes used to estimate potential populations are based habitat effectiveness values were developed in cooperation with the Oregon Department of Fish and Wildlife.

- Included information on newly designated Wild and Scenic rivers, and on eligibility studies on potential wild and scenic rivers.

- Extensive changes were made to the analysis of the risk of cumulative effects between the DEIS and FEIS, in response to substantative public comments. The FEIS considered three watershed characteristics in assigning Watershed Risk, erosion levels, hydrological recovery, and riparian condition; the DEIS considered only the first two components. The terminology used to describe the risk of watershed effects was changed to "High", "Medium" and "Low" from "Probable", "Possible", and "Unlikely", as part of the revised analysis method.

- The FORPLAN model used for the FEIS included watersheds (averaging 54,000 acres) as building blocks, which permitted analysis of the timber harvest levels prescribed by FORPLAN to be analyzed, rather than assuming that harvest was distributed evenly across all watersheds as was done in the DEIS. In FORPLAN, the relative sensitivity of watersheds to increases in peak flows was identified, and FORPLAN was programmed to distribute the harvest according to watershed sensitivity in all alternatives, to minimize the risk from increase peak flows.

- In Alternative W (PA), the sensitivity of smaller subdrainage areas (average 3900 acres) was described, and the level of harvest which would be compatible with maintaining stream channel stability in each subdrainage was estimated. This information was included in FORPLAN modelling.

- The analysis of potential sediment was changed to focus more on the potential sediment from mass movement, specifically debris slides in the FEIS. The potential sediment yields and discussion of effects in the DEIS included calculations of surface erosion. Studies have shown that a very small portion of surface erosion reach streams, lakes, or wetlands.

- Changes were made in the design of each alternative, so that all alternatives considered the possiblity of achieving fish passage around reservoirs on the South Santiam and McKenzie Rivers, and increased success in passage around Fall Creek.

- Changes in the estimates of smolt habitat capability were made in response to direction in the 1970 Memo, dated May 1, 1987 on Anadromous Fish Planning Coefficients.

- A discussion on sensitive fish species was added.

- Changes were made in the acres of land suited for timber production. Four soil types were added for an increase of about 29,000 acres.

- The empirical yield tables were updated to reflect growth through 1994, and adjusted for defect and breakage by species and size class.

- The Forest Inventory was adjusted to account for harvest through FY 1989.

- A new managed yield table was included in the DF/H and DF/TF working groups to allow one heavy commercial thinning.

- The Regional Fertilization Policy was changed to allow fertilizer to be added to stands with at least 60% Douglas fir.

- New Forestry concepts were applied to long-rotation management areas to provide habitat for old growth dependent species at an earlier age.

- A section was added to discuss the effects of the alternatives on Climate.

ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVES

The environmental consequences for all alternatives, except the No Change (NC) Alternative, fall within certain limits because of Forest-wide management requirements imposed to ensure long-term productivity of the land. While the frequency of occurrence of an output or effect may vary between alternatives, the environmental consequences may not be significantly different between the alternatives due to the common application of standards and guidelines (S&Gs) across all alternatives (except the NC Alternative) or due to the low sensitivity of the resources involved. These S&Gs apply to all management area prescriptions and are designed to protect Forest resources and mitigate adverse impacts.

The estimated effects of the alternatives result from the application of various combinations of management prescriptions. This mix of prescriptions generates different levels of resource outputs, goods and services. For each alternative, the interaction between the level of outputs and the source of production generates distinct environmental consequences. A familiarity with both quantifiable and qualitative outputs and effects is crucial for understanding the analysis and evaluation of environmental consequences. Quantitative outputs as well as nonpriced benefits and environmental qualities all contribute to the environmental consequences of the alternatives.

Environmental Consequences Of The Alternatives On Soil

Introduction

Long-term soil productivity is the natural capability of the soil to sustain the growth of plants and plant communities over time. It also includes the maintenance of soil conditions so that quality ground-water is supplied to lakes, wetlands and streams. Since most Forest uses ultimately depend on a productive soil resource, maintenance and enhancement of long-term soil productivity is widely recognized as a basic requirement of Forest management.

Effects of the Alternatives on Soil

Both external and internal factors affect soil productivity. External factors, such as climate and geology, are not influenced by Forest activities. Internal factors which can be modified by Forest activities are soil nutrients, and soil structure.

The effects of the alternatives on soil productivity will be described in terms of: (1) changes in nutrient levels and cycling; including application of fertilizer, and the role of surface soil organic layers; and (2) changes in soil structure, such as soil compaction and erosion. Forest management activities, such as timber management and road construction have the potential to affect soil productivity. The Forest and Regional Standards and Guidelines (S&Gs) define what kinds and levels of soil disturbances are acceptable, and what levels are considered detrimental to long-term soil productivity.

Table IV-1 displays the amount of the principle activities affecting soil that are scheduled for each alternative. This information provides the basis for the following discussion of effects.

Table IV-1. Primary Activities Affecting Soils

Activity	Units	NC [1]	K	A	J	W	D	L
Fertilization M Acres [1]	Decade 1	NA	102	88	118	96	102	56
	Decade 2	NA	92	99	74	79	74	24
	Decade 5	NA	101	107	77	73	68	26
Road Construction	Miles							
	Decade 1	NA	550	500	450	400	300	120
	Decade 2	NA	90	130	70	70	50	40
	Decade 5	NA	40	50	40	20	10	10
All Harvests [2]	M Acres							
	Decade 1	186	157	153	128	119	126	35
	Decade 2	NA	128	123	117	115	103	37
	Decade 5	NA	146	129	183	149	140	72
Final Harvests [3]	M Acres							
	Decade 1	144	126	121	102	91	99	33
	Decade 2	NA	126	121	100	94	100	28
	Decade 5	NA	118	116	82	81	85	23

[1]Total of acres scheduled for fertilization each decade.
[2]All harvests include clearcuts, shelterwoods, and thinnings.
[3]Final harvests include clearcuts and shelterwoods only.
[4]FORPLAN was not used with this Alternative. NA means the information is not available.

Nutrients - The cycling of nutrients through forest soils is essential for the productivity of plant communities, because the largest pool of nutrients exists in the soils. Other major sources of nutrients for the soil is the weathering of bedrock, and inputs from atmospheric sources (Waring and Schlesinger, 1985). Various soil animals are important in the process of decomposition of organic matter, such as needles and leaves, and bark. The majority of the chemical transformations are performed by bacteria and fungi in the upper soil layers.

Nutrient Addition - Nutrients added to the site by management practices such as fertilization would be designed to increase the availability of nitrogen to tree species resulting in additional vegetative growth. Nitrogen, usually in urea form can be applied directly to these soils.

The Forest has been participating in fertilization research for over 10 years, resulting in considerable information about timber growth response on various soil types (Legard 1980). Fertilizer trials have been made on approximately 30% of the Douglas-fir/hemlock zone, primarily on gentle slopes (less than 30%) at low elevations. Based on these trials, all alternatives propose to apply fertilizer to timber stands on suited lands composed of greater than 60% Douglas-fir.

Differences between alternatives in the number of acres fertilized during the first decade range from 56,000 to 118,000 acres, with 96,000 acres in Alternative W (PA). Use of fertilizer in the fifth decade ranges from between 26,000 acres to 107,000 acres, with 73,000 acres for Alternative W.

Nutrient Removal - Soil nutrients would be removed from the site through several processes; volatilization by fire, removal of vegetative material, and leaching.

Removal of the surface soil organic layer and large woody debris (downed logs, and limbs) results in direct loss of soil organic matter, certain plant nutrients, and a supply of energy to soil microorganisms.

Soil microorganism activity has been directly linked to soil productivity (Harvey et al. 1979). Organic matter in the surface layer has been found to be a primary source of nitrogen for young tree growth (Little and Ohman 1985). Large woody debris has been found to be an important link in the life cycle of symbiotic fungi which greatly enhance the ability of the roots of young conifers to take up water and nutrients (Maser et al. 1985). Because of this interdependence between above ground organic material supplies and below ground productivity processes, management of the long-term supply of large woody debris and surface soil layer can strongly influence soil productivity. As a result, the Forest has included S&Gs for the maintenance of large wood and organic matter on soils.

Fires of a high intensity, and moderate intensity fires of long duration, can cause severe impacts to soils. These impacts include the volatilization of up to 85% of the nitrogen content of leaves and twigs (Waring and Schlesinger); the loss of beneficial microorganisms; and the loss of organic matter for the nutrient holding capacity of the soil. However, it appears that prescribed burning of Forest residues at cooler temperatures has minimal effects on the long-term nitrogen content of surface soils. (Kraemer and Herman 1979). High intensity fires can also result in extensive mineral soil exposure and/or the creation of hydrophobic or "nonwettable conditions" which then accelerate topsoil erosion (Boyer and Dell 1980).

Research has not yet been able to quantify potential impacts to timber stand growth from surface organic matter disturbance. Thus, with the apparent long-term stability of nitrogen (the nutrient most subject to change), site productivity does not appear to be affected by prescribed burning when low to moderate fire intensities are utilized to protect a sufficient portion of the duff layer. Experience gained on the Forest over the last 10-15 years has led to guidelines ensuring that low to moderate fire intensities are used to protect surface layer organic matter.

Removal of forest products represents a loss of the nutrients from the forest ecosystem. In most instances the removal of woody biomass results in only a small percentage loss of the total nutrient elements in forest ecosystems, because the largest pools are in the soil, and because the foliage and branches that are left behind contain a large portion of the nutrient pool in the vegetation. However removal of whole trees for pulpwood or biomass energy would result in substantially greater nutrient removals. These may be replaced by natural processes, nitrogen fixing species or fertilizers (Waring and Schlesinger 1985).

Removal of nutrients by leaching into water runoff varies by season, and vegetation type. The highest rates of leaching have been observed following decomposition of organic matter four years after clearcutting (Adams et al. 1989). This is also discussed in the section on Water.

Soil Structure - Soil structure develops over long periods of time and influences the availability of water and nutrients to plants. Some management activities have the potential to alter soil structure. Two major changes which have the potential to occur are compaction and erosion of soil profiles.

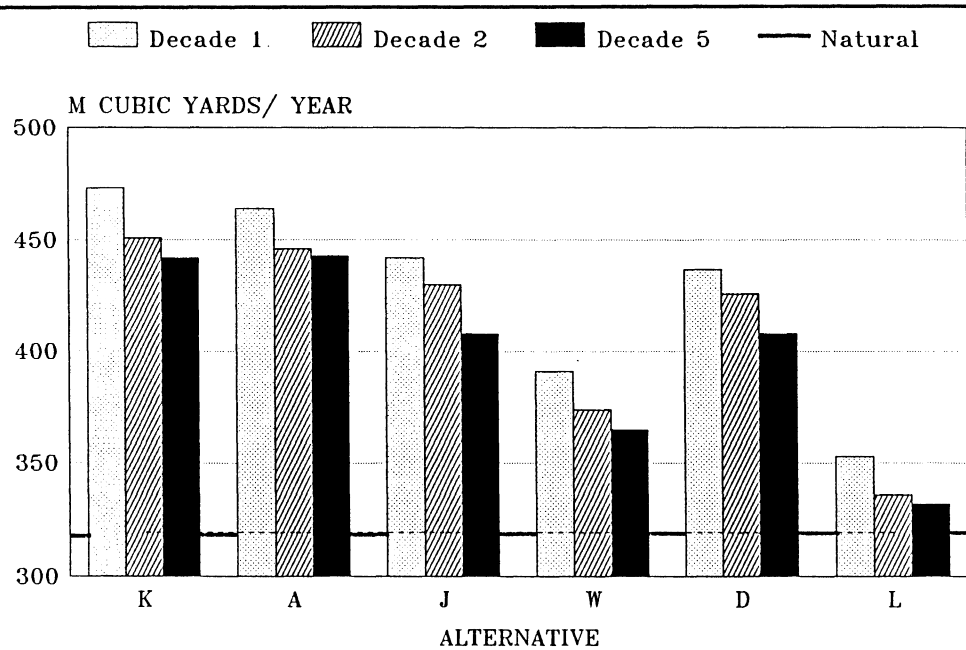
Compaction - Soil compaction occurs when soil pore space is reduced in size because of physical pressure exerted on the soil surface. Compaction results in soil conditions that have reduced infiltration, permeability, and gaseous and nutrient exchange rates. Physical resistance to root growth can also occur in soils of high density. Soil compaction can occur on almost all soils with repeated passage of heavy equipment. At least 60 percent of the increase in bulk density in a well used skidtrail occurs after the first three to 5 passes (McNabb and Froehlich 1984). The area in compacted skidtrails can often range from 18 to 40% of the harvest area (Sidle 1980, Froehlich 1974, Dyrness 1972) from a single harvest entry with tractor skidding. Repeated entries for thinnings tend to increase the area in skidtrails, further impacting soil productivity (Chambers 1977). Mechanical slash piling also significantly increases the area disturbed and compacted.

Timber stand growth losses from compaction caused by tractor logging and tractor piling have been found to be significant and persistent. Stand growth loss estimates range from 5 to 13% (Wert and Thomas 1981, McNabb and Froehlich 1984). Growth losses are greatest for young stands, and lesser for older stands due to different portions of the root systems within affected soil layers. Natural recovery rates are generally slow in this region because the mild climate causes limited freezing and thawing of the soil. As a consequence, it is expected that compacted soils will remain compacted over the rotation of managed stands (McNabb and Froehlich 1984, Froehlich et al. 1983). Soil compaction also reduces water infiltration, and may result in increased overland flow. These conditions contribute to increased erosion and higher peak flows. Compaction can be minimized by avoiding or carefully managing tractor logging and slash piling.

Erosion - Surface erosion occurs from the forces of raindrop impacts, gravity (as with dry raveling), and wind in areas where soils lack protective ground cover. Erosion can be greatly increased by freeze-thaw action on some steep slopes. The extent to which this effects soil productivity has not been thoroughly researched. See the Soils and Geology sections in Chapter III for further discussion on erosion.

When soil is eroded by mass movement it often becomes less productive as soil layers are mixed. Removal of tree and shrub cover from steep slopes can accelerate mass movement on soils which are prone to landslides due to the loss of root strength. Groundwater regimes, which affect stability of slump-earth flow complexes, may also be affected by infiltration rate changes associated with timber harvest and road location.

Figure IV-1. Total Forest Erosion



Data for Alternative NC not available

Table IV-2. Erosion by Alternative [1]

	Alternatives						
	NC [2]	K	A	J	W	D	L
Decade 1							
Debris Slides							
Natural	240.3	240.3	240.3	240.3	240.3	240.3	240.3
Roads[3]	--	14.2	13.2	12.2	11.6	10.1	7.6
Timber Harvest[3]	--	78.2	73.9	61.6	16.9	61.5	10.8
Surface							
Natural	79.3	79.3	79.3	79.3	79.3	79.3	79.3
Roads[3]	--	8.5	7.6	6.8	6.0	4.6	1.8
Timber Harvest[3]	--	53.0	49.8	41.6	37.0	41.2	13.4
Total	--	473.4	464.1	441.7	391.0	436.9	353.0
Decade 2							
Debris Slides							
Natural	240.3	240.3	240.3	240.3	240.3	240.3	240.3
Roads[3]	--	3.8	4.0	2.7	2.8	2.1	1.2
Timber Harvest[3]	--	76.4	71.7	63.8	12.7	63.2	4.0
Surface							
Natural	79.3	79.3	79.3	79.3	79.3	79.3	79.3
Roads[3]	--	1.3	1.9	1.1	1.1	0.7	0.6
Timber Harvest[3]	--	50.4	49.0	42.7	38.2	40.7	11.1
Total	--	451.4	446.2	429.9	374.2	426.3	336.4
Decade 5							
Debris Slides							
Natural	240.3	240.3	240.3	240.3	240.3	240.3	240.3
Roads[3]	--	1.0	1.2	0.8	0.5	0.2	0.2
Timber Harvest[3]	--	73.1	73.2	52.7	11.1	54.0	3.1
Surface							
Natural	79.3	79.3	79.3	79.3	79.3	79.3	79.3
Roads[3]	--	0.6	0.8	0.6	0.3	0.1	0.1
Timber Harvest[3]	--	48.1	48.0	34.6	34.0	34.4	8.9
Total	--	442.3	442.6	408.3	365.4	408.2	331.8

[1]Values represent estimates for the average annual amount of erosion in thousands of cubic yards.
[2]NA = Data Not Available. Alternative NC is estimated to be similar to Alternative K.
[3]Amounts include erosion from decade indicated and a smaller amount carried over from previous decade.

Erosion, both surface and mass movement, would increase above natural levels, based on the acres harvested, acres of unstable soil types harvested and miles of road constructed in each alternative. Erosion index values shown as a basis to compare alternatives are displayed in Table IV-2 and Figure IV-1 above. Estimated erosion volumes do not indicate amount that would be delivered to streams or project downstream effects. The potential effects of erosion on water quality are discussed in the Water Section of this chapter.

The rate of road construction and consequently erosion from newly constructed roads declines after the first decade in all alternatives since most of the transportation system would be in place by the end of the first decade. Of the erosion over natural levels that is generated in the first decade, approximately 13 to 28% would come from new roads with the remainder coming from harvested areas.

Soil disturbance is an unavoidable consequence of Forest management activities such as timber harvest, road construction, and to a much lesser degree, intense recreational use such as repeated use of campsites and trails.

For each harvest entry, the extent of soil disturbance depends upon a number of factors. Soil type and condition, terrain, the volume and size of timber removed, the size of units, the weather, contract compliance, and the skills of individual equipment operators all contribute to the intensity of impact. The area impacted by final timber harvest, the harvest method employed, and the method of site preparation directly affect the degree of disturbance to the soil surface. Differences in acres harvested between alternatives are the most direct indicator of relative risk to soil productivity through compaction.

Differences Between Alternatives - Harvest options vary widely in their impact on the soil according to the yarding system used. Cable and aerial yarding systems affect a much smaller area than does tractor-based logging. High-lead systems may disturb only from 15 to 20% of the harvested area (Dyrness 1967, Sidle 1980). Impacts tend to be higher if downhill yarding is used. Skyline systems generally disrupt less than 10% of the area (Dyrness 1967), and aerial systems affect less than 5% of the ground. In all of the alternatives, the majority of the Forest (60 to 70%) will be harvested by skyline systems. The remainder of the harvested areas will use ground based systems (20% to 30%) or aerial systems (10% to 20%).

Alternative NC would impact the most acres with final harvest during the first decade, with the amount of final harvest gradually declining as commercial thinning increases to the point of providing over half the harvest volume by decade five. Final harvests in Alternatives K, A and J would impact almost as many acres in each of the first two decades, and then decline to lower levels in decades three, four, and five. Final harvests in alternatives W (PA), D, and L would impact progressively fewer acres each decade.

Alternative K would produce the highest amount of erosion in the first decade (153.9 thousand cubic yards annually), representing an increase of 48% over the natural rate and nearly equal to current erosion levels (154.8 thousand cubic yards annually).

Alternative A would produce approximately 144.6 thousand cubic yards annually in the first decade. This represents an increase of 45% above the natural levels and a decrease of about 7% from current erosion levels. In the first decade, Alternatives J and D generate slightly lower amounts annually (122.1 and 117.4 thousand cubic yards respectively). Alternatives J and D would result in erosion levels decreasing approximate 21% and 24% respectively from current erosion levels.

Alternatives W (PA) and L produce the least annual erosion (71.5 and 33.5 thousand cubic yards respectively in the first decade). For Alternative W (PA), this corresponds to an increase of 22% above natural levels and a decrease of approximately 54% from current erosion levels. For Alternative L, this represents an estimated increase of 10% above natural erosion levels and a decrease of approximately 78% from current erosion levels.

In the fifth decade as the area of final timber harvest decrease, and road construction decreases in all alternatives, erosion would also decline. Alternatives K and A would generate the highest annual amounts of erosion at 122.8 and 123.0 thousand cubic yards respectively. Alternatives J and D would produce similar amounts annually of approximately 88.7 thousand cubic yards. Alternative W (PA) would produce a lower volume estimated to be 45.9 thousand cubic yards annually. Alternative L would generate the least amount of erosion of approximately 12.3 thousand cubic yards annually. Alternative NC is estimated to fall in the same range as K and A because the majority of the harvest volume by the fifth decade comes from commercial thinning. The effects of commercial thinning on erosion are estimated to be negligible. This is due to the low degree of disturbance to the soil duff layer where stands are thinned by cable logging systems and rarely treated with fire.

Cumulative Effects on Soil

The cumulative effects of management activities over an area are considered in the S&Gs which require that no more than 20% of an area is cumulatively displaced, puddled, or compacted, and specifies the amount of soil cover and large woody debris to be maintained on the ground. At this time no satisfactory means of testing, or unit measure of long-term soil productivity, has yet been devised. The survival and growth of planted seedlings give an indication of changes in site productivity, but little is known of how indicative short-term performance is of long-term productivity.

Mitigation Measures for Soil

In most situations, preventing soil impacts is the most effective and feasible way of ensuring long-term soil productivity. Determining the suitability of specific soils for timber harvest activities is an important first step in preventing soil related impacts. In responding to NFMA regulations, 144,851 acres of available, forested lands are currently classified as unsuited for timber management. No timber harvest activities are scheduled on those lands because of the potential for irreversible soil damage and/or the inability to ensure regeneration of forested stands within 5 years. Lands that exceed 30% slope gradients, or soils that have high clay or silt content, are not planned for tractor yarding or slash piling because of equipment limitations that lead to excessive soil displacement and compaction.

One-end suspension or full suspension cable yarding systems are used to avoid a high degree of soil disturbance on soils that are highly susceptible to displacement, surface erosion, mass movement, or compaction. Both duff and fuel moistures are used to determine when slash can be burned with minimum impact to surface organic material. Planned slash treatments are either low intensity broadcast burns, burning via small handpiles, or yarding of slash without burning on these more sensitive soils.

Ground skidding equipment is primarily restricted to designated skid trails or not allowed. Reducing the effective weight of the tractors and reducing the number of trips over a piece of ground are other means to reduce the risk of soil compaction and displacement (Froehlich and McNabb, 1983). Yarding over frozen ground, or over a deep, solid snow pack reduces soil disturbances and can protect advanced regeneration. In many situations, cable systems are used for yarding in place of tractors to reduce soil disturbance. Tractor piling will generally not be considered an option unless justified on a unit by unit basis. Additional measures to reduce soil compaction and displacement resulting from tractor piling include cable piling, handpiling, and low to moderate intensity broadcast burning. Rehabilitation with equipment capable of reaching subsoil depths (generally 10 inches or greater) will be used to loosen and break up compacted soil when appropriate.

On slopes exceeding 30%, cable yarding systems are used. Uphill yarding is preferred over downhill yarding to reduce log gouging of the soil. Cable systems that partially or fully suspend logs do not compact or deeply disturb as much ground as no suspension systems (Dyrness 1972). Long-span cable yarding systems will reduce the road densities needed for ground skidding and shorter span systems. This practice avoids soil and water quality impacts that may result from additional road construction.

Management prescriptions, standards, and guidelines require special management considerations whenever activities have a potential of triggering mass movement events. Avoidance of problem sites is the alternative most preferred. Other than avoiding timber harvest on problem sites, ways to reduce the chances of mass movement include: retaining more trees, shrubs, and ground cover than normally done during timber harvest; using cable yarding systems that one-end or fully suspend logs; allowing felling and yarding only during dry soil conditions; draining wet, unstable areas; and avoiding broadcast burning. Ways to reduce the chance of mass wasting associated with road construction include: avoiding problem sites; not overloading or undercutting unstable ground; special spacing, sizing, and location of culverts; stabilizing cut and fill slopes, (e.g., rock buttresses, retaining walls, and planting); inspecting and cleaning of ditches and culverts; building full-bench roads where slopes exceed 55%, and eliminating side-cast waste; and monitoring of road conditions after construction.

To maintain long-term productivity, compacted areas such as skid trails, landings, temporary roads, stock loading areas or campsites can be tilled or subsoiled. Easily eroded sites can be mulched, fertilized, and seeded or planted. Cross ditches can be installed at appropriate intervals to direct water flowing over compacted surfaces such as trails and roads. Roads can be made more erosion resistant by surfacing. On the older Forest roads side-cast pullback will be implemented to reduce the debris avalanche potential.

These mitigation measures would be used in all the alternatives. The particular measures used would vary depending upon the site specific conditions. Project analysis undertaken prior to project implementation, ongoing project administration, and project monitoring would determine the specific needs and measures used. The degree or amount of specific mitigation measures likely to be used used in each alternative is relative to the amount of acres harvested (Figure IV-1) or miles of road constructed.

Relationships With Other Agency Plans or Policies for Soil

There are no known conflicts between the effects of the alternatives on soil and the plans or policies of other State, Federal, or local agencies.

Information Needs

The Forest recognizes gaps in existing data and research needs that would be desirable to fill prior to the preparation of the next Forest Land and Resource Management Plan. In the area of maintaining long term site productivity, more information is needed on the following:

- The effects of different harvest practices and removal of biomass.
- A further assessment of the effects of burning and compaction.
- The effect of management practices on the incidence and severity of pathogens and insects as they effect long-term productivity.

Environmental Consequences of the Alternatives on Water

Introduction

This section describes the potential adverse direct, indirect, and cumulative effects of the proposed alternatives on water quantity and quality in streams, lakes, and wetlands; on stream channel conditions. Water quality refers to the quality of the water within streams, lakes and wetlands, while stream channel condition refers to the physical structure of the stream substrate and stream bank stability. Stream channel condition is a strong indicator of the quality of habitat for all aquatic species for which anadromous and resident salmonids are Management Indicator Species.

This section discusses both water quality and stream condition because many of the same processes affect both. The influence of water quality and stream condition on beneficial uses is considered here and in the Fish section because fish populations are considered an important beneficial use throughout the Forest.

Direct, indirect and cumulative effects are evaluated against the requirements established in NFMA regulations and the Clean Water Act. Other laws are mentioned where applicable. Management Requirements described in NFMA include the following:

- Minimize serious or long-lasting hazards from flood and erosion unless they are specifically accepted.

- Protect streams, streambanks, shorelines, lakes, wetlands and other bodies of water.

- Special consideration shall be given to land and vegetation for approximately 100 feet from the edges of all perennial streams, lakes, and other bodies of water. No management practices causing detrimental changes in water temperature or chemical composition, blockages of water courses or deposits of sediment shall be permitted within these areas which seriously and adversely affect water conditions or fish habitat.

The Clean Water Act declares a policy to "restore and maintain" clean water (Sec.101) and directs states to adopt antidegredation policies. The state antidegradation policy and implementation methods must safeguard existing water uses. No degradation is permitted in "Outstanding National Resource Waters" which includes designated Wild and Scenic Rivers.

Other beneficial uses to be protected are those identified by the State of Oregon (OAR 340.41) and discussed in Chapter III. These include anadromous and resident fish spawning and rearing, private and public domestic water supplies, hatchery intakes, use by wildlife, boating, aesthetic recreation, hydropower, and several others. Stream Classes are defined according to the beneficial uses which occur. Class I streams are those with anadromous fish, significant sports fish, and domestic water intakes. Class II streams are used by resident fish, and Class III stream are other perennial streams. Class IV streams are intermittent. The water quality and stream conditions in Class I and II streams is of primary concern however the influence of Class III and IV streams is equally important in determining the effects in downstream reaches.

Quantitative measures of water quality needed to provide for many of these beneficial uses has not been determined. Where the State of Oregon has established numerical standards designed to protect beneficial uses (ie. for turbidity and temperature), application of Best Management Practices is the primary means of achieving these standards. In the absence of models which can predict under what circumstances these numerical standards would be met, the differences between the alternatives is described in terms of *risk* of not protecting these beneficial uses. This risk is described in the section on Cumulative Effects.

Direct and Indirect Effects

All alternatives propose activities which have the potential to affect water quality or stream condition to varying degrees. Activities with potential to cause adverse effects are timber harvest, road management, recreation use, and wildlife management. The potential direct and indirect effects from proposed alternatives fall into 5 main categories; changes to riparian conditions, increases in levels of sediments in streams, changes in runoff patterns, changes to chemical characteristics, and changes to water yield. Effects to these 5 watershed processes are described below.

Changes in Riparian Condition - Riparian areas, floodplains and wetlands are the physical link between the upslope terrestrial ecosystem and the stream, lake, or wetland ecosystems. Riparian areas provide shade, large woody material (LWM), and small organic material to aquatic habitat. Riparian areas are also a particularly diverse part of the terrestial ecosystem, providing critical plant and wildlife habitat diversity and 80% of dispersed recreation (Clark et al. 1984). Riparian areas commonly have highly productive timber sites and frequently are the most economic road locations. A full description of the effects of harvest in riparian areas is found in the Vegetation-Riparian section of the Chapter IV. Discussion here is limited to the effects of riparian management on water quality and stream condition.

Practices in riparian areas which have the potential to effect water quality and stream conditions are those which change a) shade, b) streambank stability, c) the rate of input of LWM, d) floodplain characteristics, e) wetland characteristics. These are described in more detail below.

Shade - Increased solar radiation has the potential to increase water temperatures following removal of vegetation.

The direct effect of removal of shading vegetation from streams is to allow more solar radiation to reach the water. The indirect effect is that during summer months water temperatures increase. The Forest is required by the State Water Quality Standards to maintain stream temperatures below specific levels. In cases where summer streamflow is not influenced by snowmelt and where past practices have removed riparian cover, temperatures standards are sometimes exceeded during summer days.

The beneficial use most effected by increases in temperature are fish, particularly Bull Trout in the McKenzie River sub-basin, and fish in hatcheries fed by Salmon Creek.

The degree to which these potential effects occur is determined by the amount of timber harvest and road building in riparian areas and on the methods used. A prescription was developed to determine the maximum level of harvest that would be compatible with meeting Management Requirements specifically related to meeting State water quality standards for temperature. It was determined that timber harvested at rotations lengths of 200 years for Class I and II streams, and 140 years for Class III streams would provide enough shade to maintain stream temperatures based on average widths of streams as determined in the field. (Stewart & Skeesick. 1981) This prescription was modeled as harvest of no more than 5% per decade along Class I and II streams and 7% per decade along Class III streams.

This management requirement prescription was selected for riparian areas in Alternatives A, K, and J. The prescription selected for Alternative D was designed to provide higher quality stream conditions, and would schedule harvest at 5% per decade only on Class III streams on an average. No programmed harvest was scheduled from Class I and II riparian areas. Riparian prescriptions for Alternatives W and L were designed to provide a high level of assurance that all riparian dependent resources would be protected including riparian dependent plant and animal species; and to maximize the overlap of resource use in these areas. In these two alternatives riparian areas are intended to provide distribution of interior wildlife species, provide optimal thermal cover for big game, and provide quality recreation, in addition to meeting requirements for water quality and stream conditions. No programmed harvest is scheduled for riparian areas in these alternatives. The cumulative reduction of LWM is closely correlated with the cumulative acres of riparian areas harvested which is shown in the section on Riparian vegetation in this Chapter.

Riparian harvest under Alternative NC is taken from the current Land Management Plan, where it was termed timber yield from Streamside Management Units, part of the Special Harvest Component. Riparian areas associated with Class I, II, and III streams were grouped together with a projected timber yield of 72%, which approximates a 140-200 year rotation.

Streambank stability - Direct changes to channel condition have the potential to occur where streambanks are disturbed. Direct distubances can occur during timber harvest, construction of road crossings and trail crossings, and by heavy recreational or livestock use on streambanks.

As used here, channel condition describes the stability of stream banks and the composition of stream substrate. The importance of these characteristics to aquatic habitat is described in the section on Fish. Disturbance of vegetation and soil on streambanks can result in increases in sediment to the stream, and reduction in stable, vegetated overhanging stream banks.

Stable stream banks provide fish shelter, and minimize the risk of increases in turbidity. Substrate which consists of well sorted gravel, with less that 25% fines is considered the best quality spawning substrate.

Disturbance of vegetation and soil has the potential to occur when logs are not fully suspended over streambanks during yarding from or through riparian areas. Streambank disturbance also has the potential to occur during and following construction of road crossings. Road construction which creates large cut or fill slopes adjacent to the stream have the highest potential for adverse effects. Increases in streambank erosion have the potential to occur when culverts are incorrectly placed so the stream current is directed into erodible streambanks. Because of the proximity to the streams, a relatively small disturbance from any of these activities can have an immediate adverse effect to beneficial uses in the immediate area.

On some landtypes root strength is required to maintain streambank stability. Field inventory for the 1977 plan determined that 21.5% of Class I, II and III riparian areas would need to be fully protected from timber harvest in order to maintain streambank stability, because the areas were too steep and unstable to be acceptably managed.

Localized damage to streambanks has the potential to occur in areas of heavy use by livestock. The application of BMP's include measures to control livestock distribution. Only the existing allotment is proposed to continue under the alternatives.

All alternatives propose the use of BMPs for operations in the riparian area. Alternatives with programmed harvest in these areas have a higher risk of direct changes to the streambank occurring.

Large Woody Material - Future management of vegetation in riparian areas has the potential to change the long-term input of Large Woody Material to streams, wetlands and lakes, with subsequent changes to stream channel condition, and streambank stability.

Trees in riparian stands provide input of Large Woody Material (LWM) to the water. As trees in riparian stands are blown over, or the tops broken out, the wood is gradually recruited into stream channels, and functions as an integral part of the stream channel. Research indicates that 90% of large wood is recruited from within 100 feet of the channel on all stream classes.(McDade)

LWM influences the stability of stream channels by armoring streambanks, and dissipating the velocity of water. The role of LWM in a stream differs between stream channel types. A large reduction in the levels of LWM in streams has been shown to correlate with stream widening on low gradient streams.(Grant et. al 1989) Stream widening would result in loss of productive land area, and shallower, more exposed aquatic habitat. Low gradient streams are generally Class I and II streams. On steeper gradient streams, generally Class III and IV streams, instream wood controls the flow of sediment through the system by storing silts, gravels, and cobbles behind them. (Megahan, 1982) Changes in the levels of LWM in Class III and IV effects levels of sediment transported to Class I and II streams, and is discussed more thoroughly in the section on sediment.

Levels of LWM strongly influence the creation and stability of aquatic habitat conditions such as pools, side channels, and well-sorted gravels.

Over the next 50 years, decreases in the number and size of trees falling into the streams would increase the risk that current levels of stream channel stability and the complexity of aquatic habitat would not be maintained over the long-term. Monitoring during the next decade would begin to provide important information on the correlation between existing condition of riparian areas, complexity of aquatic habitat, and stability of stream channels.

As of 1981, 39% or 1,313 miles of Class I, II, and III streams were in or adjacent to harvest units or roads (Stewart and Skeesick, 1982). The amount of protection afforded these streams was variable, but in general, during the 1960s and early 1970s LWM was removed from streams where accessible. Stream habitat features which are created by the presence of large woody debris were reduced, and will not recover until adjacent riparian stands have timber of sufficient size and condition to provide trees which are stable in the stream environment. This potentially occurs beginning 60 to 80 years after harvest in areas where conifers are established. It may take several hundred years for conifers to develop where deciduous stands are currently dominant.

Alternatives A, K,and J would result in forest-wide reductions of input of LWM of more than 4% in the first decade, 7% in the second decade, and 18% by the 5th decade. Alternative D would result in a 0% reduction for the first decade, 2% by the second decade, and 6% by the 5th decade. Alternatives W and L would program no additional harvest over the next 50 years, thus allowing recovery of riparian areas harvested in the past.

Floodplains - Future management of timber within the 100 year floodplains of streams, wetlands and lakes have the potential to alter the functioning and value of floodplains.

Floodplains function to temporarily store floodwaters thereby reducing the risk of downstream flooding. These areas also provide safer, slackwater habitats for fish during high flows. Characteristics of floodplains which reduce stream velocity are standing and downed trees and other vegetation which creates roughness of the floodplain surface.

Executives Order No. 11988 requires that the agency take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains. In all the alternatives management activities within the 100 year floodplain would comply with requirements of Executive Order 11988. Alternatives with programmed harvest from Class I and II streams have a higher risk that these values would not be protected.

Lakes and wetlands - Future management of vegetation in riparian zones on lakes and small wetlands has the potential to adversely effect the water quality and aquatic habitat of these areas.

The requirement to provide protection for the water quality in wetlands and lakes is established in the Clean Water Act. Direction to provide for other beneficial values of wetlands is established in the Wetland Protection Executive Order 11990. This direction has been included in the S&Gs for all alternatives. Alternatives NC, A, K, and J accept higher risk of adverse effects to these resources by scheduling timber harvest from lakeside areas. Alternatives W, D and L do not schedule harvest from lakeside areas.

Small wetlands, such as bogs, ponds, and overflow channels would be evaluated for beneficial values and potentials under all alternatives. These areas are too small to be evaluated for programming harvest.

Riparian Summary - In Alternatives W and L on Class I, II, and III streams, an area of varying width immediately adjacent to the channel would be withdrawn from programmed timber harvest. As a result these alternatives have a high probability of success in protecting beneficial uses that are dependent of cool water temperatures, protecting streambanks, wetlands and lakes, and minimizing serious and long-lasting hazards from floods. The recovery of adjacent, previously harvested riparian stands, as well as stream channels would be promoted. The other alternatives carry a higher risk of not meeting these objectives.

The riparian acre base under Alternative NC is incomplete, and proposed management includes harvest on lands on which current technology cannot assure that irreversible resource damage would not occur. As a consequence, Alternative NC poses the greatest risk to water and fisheries resources.

Changes in Sediment - Water quality in Class I and II streams is often characterized by turbidity levels of the streams. Turbidity usually increases as the amounts of sediment particularly the clay and silt sized particles which reach the stream. Stream conditions and habitat are influenced by the amounts of sediment which is deposited in the stream channel. Water quality of lakes, wetlands and reservoirs is effected by the amount of sediments which travel through Class I, II and III streams, or the amount of sediment which remains suspended in reservoirs, lakes and small wetlands.

Although some sediment is necessary in stream ecosystems, optimum or threshold amounts and sizes have not been identified. The adverse effects of smaller sized material has been shown to reduce the survival of salmonid fry as they emerge from spawning gravel. Increases in sediment can also alter channel width, depth and gradient, with other indirect effects as the channel adjusts to additional bedload. (Bradley, Williams, Klingeman, 1989)

The risk of increasing sediment delivery to the streams increases with the acres of ground disturbing activities and varies according to the source of the eroded material. Table IV-2 in Soils summarizes the estimated relative erosion under each alternative. The primary sources of sediment is from mass movements, particularly debris torrents, and from surface erosion. The risk that these processes would result in increased stream sediment is described below.

Mass Movement - Sediment generated from mass movement, particularly debris slides, has the highest potential to impact water quality, channel stability and aquatic habitat. (Sediment generated from surface erosion is discussed in the following section.) Water quality is effected by debris slides when they reach water. No quantitative link has been made between the volume of soil moved in debris

slides and increases in water turbidity because of the extreme variation in the landtypes being considered. The conclusion can be made however that the **risk** of adverse turbidity levels increases as the incidence of debris torrents increases.
Debris slides which mix with water and continue through a stream channel are termed debris torrents. Debris slides and torrents occur as part of the natural weathering process, and most of the steep headwater channels have been subject to debris torrents at some time. Under natural conditions debris torrents would occur most frequently during major storm events when soil is saturated, and following major wildfires, when root strength is reduced. Under managed conditions, soil saturation and root strength still influence the rate at which debris torrents occur.

The distance debris torrents travel in a stream channel is largely dependent of the sinuosity and gradient of the channel. Torrents move farther in straighter, steep channels, (Swanson and Roach, 1987) and depending on the amount of LWM in the channel available to reduce the velocity of the debris torrent. (Ketcheson and Froelich 1978). Debris torrents often increase in size as they travel downstream, particularly where they fill a culvert, resulting in saturation of the road fill and complete failure of the fill material.

The force of a debris torrent travelling through Class III and IV streams often moves existing LWM and stored sediments out of these steep, headwater streams into the low-gradient streams causing increases in turbidity and bedload. The downstream channel adjusts in width and depth in response to increases in bedload. Where LWM is deposited in bedrock channels it sometimes increases aquatic habitat complexity but in some cases can make the stream temporarily impassible. After a debris torrent removes LWM in Class III and IV streams water velocities may increase and silts and gravels may be scoured from the streambanks and channel bottoms resulting in increased turbidity downstream. Streambanks are susceptible to additional erosion following removal of LWM where composed of deep soils, and where extremes in peak flow runoffs occur during rain on snow events.

Debris torrents have the potential to influence wetlands, lakes and reservoirs also. The effects to small wetlands and small lakes may be to substantially reduce the storage capacity of wetlands, and to reduce the water quality. In larger lakes and reservoirs, debris torrents would also increase turbidity. In some cases, such as Hills Creek Reservoir the material which enters the reservoir, may be very fine, clay-sized material which has the potential to stay in suspension for long periods of time. These sediments may settle out eventually, but are usually resuspended when the reservoir level is drawn down, and the exposed draw-down zone is subjected to rain-erosion. Increases in turbidity have the potential to decrease the recreational quality of the reservoir.

Debris slides occur as part of the natural, unmanaged hillslope process, and in areas managed for timber production. Studies have shown that management practices during the period of 1950 to 1980

The following sections describe the three major influence on changes to the size and frequency of debris slides.

Unstable and Potentially Unstable Landtypes - The inherent stability of the landtypes influences the changes size and frequency of debris slides.

Landtypes with the highest risk of mass movement are those which are currently "unstable". These are areas which have moved recently enough to leave observable signs on the soil profile. These have been mapped as "unsuited for timber production due to irreversible damage", and have been excluded from timber scheduling in all alternatives.

Table IV-3 Percent Suited Lands on Potentially Unstable Soils by Watershed

	Alternatives						
Watershed Name	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Lookout[1]	NA	NA	NA	NA	NA	NA	NA
L.N. Santiam	0	0	0	0	0	0	0
Detroit Tributaries	7	5	5	5	5	5	3
Quartzville	28	26	26	26	25	19	13
Middle Santiam	5	5	5	4	4	4	1
South Santiam	8	6	6	6	6	5	3
Upper McKenzie	0	0	0	0	0	0	0
Calapooia/Wiley	11	11	11	11	10	11	10
Blue River	17	15	15	15	14	14	12
Lower McKenzie	19	20	18	17	17	7	9
Quartz Creek	19	18	18	18	17	18	14
S.F. McKenzie	2	2	2	2	2	2	1
Lower Horse Creek	0	0	0	0	0	0	0
Fall Creek	28	26	26	25	23	23	16
Winberry Creek	9	8	8	8	8	8	5
Lower NFMF Willamette	8	8	8	8	7	7	5
Salmon Creek	4	4	4	4	4	4	2
MF Willamette Tributaries	20	17	17	16	15	14	5
Salt Creek	3	2	2	2	2	2	2
Lower MF Willamette	17	14	14	13	12	13	9
Hills Creek	4	3	3	3	3	3	3
Upper MF Willamette	1	1	1	1	1	1	1
Upper NFMF Willamette	0	1	0	0	0	0	0
Wilderness Lakes	0	0	0	0	0	0	0
Upper Horse	0	0	0	0	0	0	0
Canyon	7	7	7	7	7	7	5
Hackleman	0	0	0	0	0	0	0
Scott	0	0	0	0	0	0	0
Deer	0	0	0	0	0	0	0
Blowout	5	4	4	4	4	4	4
Lower N. Santiam	5	4	4	4	4	4	4
Upper N. Santiam	0	0	0	0	0	0	0
Breitenbush	8	6	6	6	6	6	4
Forest Percent	6	6	6	6	5	5	3

[1]Not included in this assessment

The next highest risk is from the group of landtypes which are "potentially highly unstable". These are generally steep tuffs and breccias, or shallow soils. Management practices on these soils require extra mitigation measures. The effects of the alternatives would closely follow the number of suited acres on potentially highly unstable landtypes and the types of mitigation measures included. Mitigation measures which would reduce rates of mass movement below levels experienced in the past 40 years are described and referenced at the end of this Water section and in Chapter II, Alternatives Considered in Detail.

The amounts of potentially highly unstable land available to harvest varies by alternative. Only a small proportion of these acres would actually be harvested in the first decade but the total amount available to harvest reflects some of the associated risk for each alternative.

Alternative NC schedules harvest on approximately 128,000 acres of potentially highly unstable land, Alternatives K, and A include approximately 115,000 acres, Alternative J includes 113,000 acres, Alternative W includes 106,000 acres, Alternative D includes 102,000 and Alternative L includes 72,000 acres. The percent of unstable land varies by watershed as shown in Table IV-3.

Timber harvest - Timber harvest has the potential to increase the rate and frequency of debris slides by reducing root strength on steep slopes.

A direct result of the harvest of trees is the loss of root strength which follows. The subsequent indirect effect under some circumstances is an increase in debris slides. Root strength is one important factor in maintaining slope stability on slopes over 60%, particularly in areas where soils naturally have low cohesion characteristics, and in areas where soils become saturated. (Hammond et al.) Slides may occur midslope on potentially highly unstable areas, on steep streambanks, and in headwall areas which are usually adjacent to Class IV streams.

Alternatives vary in treatment of these potentially highly unstable landtypes. All alternatives prescribe BMPS which are intended to maintain slope stability in order to maintain water quality. Alternatives W and L are designed to ensure a that these BMPS are very effective by including S&Gs with specific direction to maintain trees where needed for root strength, and where needed to replace LWM in steep streams with the intent of maintaining the natural rate of debris torrents movement through the stream system. In alternatives NC, K, A, J and D, no specific direction or modelling addressed this effect, consequently the risk of debris torrent occurrence would be higher in these alternatives.

Commercial thinning is expected to maintain enough root strength in these areas so that the risk on debris torrents is not substantially increased following removal of the trees.

Roads - Existing and future roads have the potential to result in increased size and frequency (rates) of debris slides where pore water pressure and/or soil shear strength is altered.

Several studies have identified roads constructed between 1950 and 1980 as primary source of debris slides, and debris torrents. (Swanson and Grant,1982) Road construction often alters the soil shear strength and pore water pressure, two important factors in the size and frequency of debris slides. As these two factors are changed debris torrents have the potential to occur more frequently. They are particularly likely to occur as soil moisture increases particularly when road fills become saturated. Road fills have the potential to become saturated when a culvert is plugged by a debris torrent or when a drainage ditch becomes blocked and runoff is rerouted from the ditch to the road surface and fill. The ditch may become blocked by failures of the cutbank material.

Some existing roads have created conditions where a high potential for debris torrents still exists. At some sites on these roads, uncompacted fills were constructed, or material excess to the construction of the road, was "sidecast" over the edge of the road, also uncompacted. Where this material is uncompacted, it becomes saturated and fails more readily than roads constructed with compacted fills. These sites have the potential to continue failing through the following decade as the root strength continues to decline. Projects to stabilize these sites are proposed in all alternatives. The amount of sidecast material with the potential to fail is estimated to be in addition to that shown in Table I-1-3. This is because during the study period, the root strength in these sidecast areas had not decreased to its current low condition.

Roads constructed in the future, in all alternatives, would use practices which are currently recognized as "Best Management Practices", such as prohibiting construction of uncompacted fills and sidecast material. These practices are described in more detail in the section on Mitigation Measures.

Road closures, as proposed in all alternatives to meet wildlife and recreation objectives, can have an adverse effect on water quality and stream condition, depending on the methods used to close the roads. Where permanent roads include culverts and cross-drains, the ability to reach these drainage structures for periodic maintenence, would be a major factor in the frequency and size of potential road failures from plugged culverts. Road closures can also result in less sediment as fewer roads are available for use during wet weather.

The relative increase in amounts of material moved by debris slides during the first decade is displayed in Table IV-4 for each watershed by alternative. Also shown in the table is the natural rate for each watershed, expressed as cubic yards per acre. Under natural conditions there is a wide variation in the size and frequency of debris slides, associated with the inherent stability of the geology. (Numbers used in this and other tables expressing erosion are index numbers for relative comparisons between locations and alternatives.) The natural level, and the increases from management activities are used as an index of the potential sediment yield and consequently an indicator of decreasing water quality and stream condition. Alternatives with low soil erosion and consequently lower sediment yield should be considered to provide the best water quality. Alternative L has the lowest risk because of the low number of acres harvested, and few miles of road constructed. Alternative W is the next lowest, followed by Alternative D. The major differences between W and D is the reduction in risk of sedimentation by protecting Class IV and headwall stream areas in Alternative W. Alternatives J, A, and K have the highest risk. More information about how the estimates were made is given in Appendix B.

Table IV-4 Percent Increase in Potential Debris Slides [1]

				% Increase above Natural Levels by Alternative-- Years 1990 to 2000						
Watershed Name	Total Natural Cubic Yards	Background Cu Yds/ Acre/Yr [2]	% Increase Years 1977-89	NC [3]	K	A	J	W	D	L
Lookout	3,048	.20	NA[4]	--	NA	NA	NA	NA	NA	NA
L.N. Santiam	5,556	.15	6	--	23	23	42	6	25	1
Detroit Tributaries	5,109	.16	21	--	18	34	14	10	22	4
Quartville	7,871	.22	39	--	61	66	21	20	59	11
Middle Santiam	8,621	.15	34	--	35	34	30	11	19	6
South Santiam	11,073	.15	20	--	30	52	40	9	40	13
Upper McKenzie	4,191	.03	12	--	11	12	20	5	2	3
Calapooia/Wiley	1,956	.19	39	--	57	54	5	8	60	16
Blue River	8,250	.20	43	--	53	47	80	19	16	13
Lower McKenzie	3,207	.15	32	--	76	65	172	14	27	16
Quartz Creek	2,707	.18	54	--	42	28	11	15	39	11
S.F. McKenzie	17,062	.15	18	--	22	24	27	6	13	3
Lower Horse Creek	3,839	.15	18	--	33	27	82	12	22	3
Fall Creek	17,681	.22	63	--	60	21	24	17	53	11
Winberry Creek	4,854	.21	48	--	38	31	8	15	21	7
Lower NFMF Willamette	15,902	.18	39	--	50	48	49	13	19	7
Salmon Creek	12,792	.15	32	--	49	47	9	12	42	5
MF Willam Tributaries	10,101	.20	50	--	53	62	65	20	45	11
Salt Creek	8,351	.12	29	--	19	28	19	9	38	6
Lower MF Willamette	19,112	.18	52	--	55	56	30	15	28	12
Hills Creek	6,636	.17	52	--	32	25	9	10	52	8
Upper MF Willamette	12,580	.11	28	--	39	39	6	9	27	5
Upper NFMF Willamette	4,240	.06	12	--	26	20	21	4	11	2
Wilderness Lakes	1,342	.05	0	--	0	0	0	0	0	0
Upper Horse	3,402	.04	1	--	0	0	0	0	0	0
Canyon	2,635	.13	28	--	62	4	7	17	46	5
Hackleman	1,682	.05	15	--	14	18	31	5	3	3
Scott	976	.03	61	--	44	18	14	24	49	13
Deer	5,059	.16	26	--	28	25	26	7	26	5
Blowout	5,300	.20	49	--	40	12	10	15	46	16
Lower N. Santiam	7,926	.13	48	--	19	43	13	14	22	11
Upper N. Santiam	6,401	.07	25	--	4	17	25	7	6	4
Breitenbush	10,822	.17	40	--	42	41	55	14	35	8

[1]Relative index values
[2]Average annual volumes
[3]Data not available
[4]Management activities in Lookout Creek are not included in this assessment

Surface erosion - Management activities have the potential to increase surface soil erosion, and the associated risk of this soil being delivered to streams. Surface soils are eroded from hillslopes and roads, each process having a different risk of being delivered to streams.

Hillslope erosion - Practices which increase surface erosion from hillslopes have the potential to cause adverse effects to water quality and stream conditions where eroded material reaches waterbodies.

Projects which result in removing soil cover on slopes are timber harvest, fuel treatment activities, and forage improvement projects. Reduction of the vegetation and duff from soils has the potential to result in increased erosion of surface soils. Where the eroding soils are adjacent to streams, wetlands, lakes and reservoirs, some of the material may reach the water, effecting the water quality and stream condition. Research has shown that the main factors influencing the rate of surface erosion from harvest units are the percent of the soil cover which is removed, and steepness of the slope. (Swanson and Grant, 1982) The main factors influencing transport of material to streams is the distance and the roughness of the ground between the eroding site and the stream. (WRENS, 1981)

Surface erosion is transported downhill in several ways. Research in the Coast Range (Bennett 1982) shows that the dominant process in areas of less than 60% slope is raindrop splash and freeze/thaw action. Overland flow is was not observed in unburned areas. On areas over 60% slope and on areas that had been burned the dominant transport mechanism was dry ravel. Most of the material moved downslope was coarser fragments, and 65% of the material moved within 24 hours of the burning. The mean distance this material traveled during the 20 month study was as follows: on slopes less than 60%, 1.1 meters; and in areas over 60%, 5.4 meters. This would imply that transport of surface erosion can be mitigated to an insignificant amount by maintaining soil cover characteristics similar to undisturbed ground in areas up to 5.4 meters or approximately 18 feet adjacent to streams.

The number of acres harvested would influence the risk of surface material reaching streams, and the effectiveness of applied BMPs. All alternatives require application of BMPS to control movement of surface erosion to streams, and these types of BMPS are usually very effective. It is estimated that the amount of material reaching the streams from surface erosion would be negligible.

Commercial thinning is not expected to substantially increase surface erosion, as the duff layer is normally retained except on designated skid roads which are treated with erosion control measures.

Roads surfaces - Road use and construction during winter months have the potential to increase movement of road surface materials to streams.

On the Forest many of the roads used as major haul routes during the winter months are adjacent to reservoirs and Class I and II streams. Erosion of road surface material during these times, and delivery of this material to water can be a major source of sediment and turbidity. In many cases the fine-grained material erodes from road gravels and subsurface. The streams most likely to be effected are those in lower elevation watersheds where the geology of the old Cascades has created fine-grained soils, and where roads are used for log haul and recreation during the winter months.

The limited study of road surface erosion indicates that the amounts eroded are highly variable with the type of road surfacing material, the length of time the road is used, and the precipitation patterns during use (Reid 1981). This variability makes quantification of the amounts of material delivered to streams very rough estimates. All alternatives would apply the same road surfacing measures, therefore, the amount of sediment generated from road surfaces for each alternative would follow the amount of volume harvested. Alternatives K, and A are highest, and Alternatives W, D, and L are lowest.

Sediment Summary - Alternative L has the lowest risk of debris slides because of the low number of acres harvested, and few miles of road constructed. Alternative W is the next lowest, followed by Alternative D. The major differences between W and D is the reduction in risk of sedimentation by protecting Class IV and headwall stream areas in Alternative W. Alternatives J, A, and K have a highest risk. Surface erosion delivery to streams is estimated to be minimal with the application of very effective BMPs. If measures are not effectively implemented and enforced, the amount of sediment from road surfaces could be very high.

Estimates of the total amounts of erosion from roads is included in Table IV-2. These estimates are of erosion, not delivered sediments.

Evaluation of Runoff Patterns

Runoff patterns refers to the quantity of runoff which occurs during different periods of time. Different parts of the runoff pattern are the "peak flows", "low flows", and "base flows". The causes and effects of peak flows are evaluated in the first section below.

For any period, the runoff pattern would be influenced by the intensity and duration of the precipitation, and the capacity of the watershed area to store the runoff. Factors which influence runoff patterns, but which are not appreciably altered by management practices are precipitation patterns, slope of area, and depth of soils. Management activities can change the capacity of the watershed to temporarily store the runoff by changing snowpack temperatures, snowpack water content, condition of vegetation, and miles of streams or ditches carrying runoff. These processes are described in detail below.

Changes in runoff patterns are most pronounced when warm wind and rain-storms occur on saturated snowpacks. These storm events occur commonly in the transient snow zone between October and March. The transient snow zone is generally between 1500 and 4000 feet elevation on the Forest. Under some climatic conditions more snow accumulates and more rain and wind reach the snowpacks in created openings than in adjacent forested areas. The variation in windspeeds between clearcuts and forested areas was confirmed by studies on the Oakridge District (Christner, 1984). As a result of these changed conditions, more rapid snowmelt can occur during rain-on snow events which are commonly accompanied by warm winds from the southwest. Research on rain on snow conditions recorded 21% more "water outflow" from plots in clearcuts than from equivalent forested areas measured at the same time. (Berris and Harr, 1983). This increased snowmelt can translate to changes in peak flows in streams, and subsurface waters.

The potential effects of created openings on runoff patterns is quantified by estimating the ability of the timber stands to intercept snow, rain, and wind. This functioning is termed the "hydrological condition" of the area, and is quantified with the Aggregate Recovery Percent (ARP) method. On this Forest a timber stand is judged to by hydrologically recovered at 25 to 35 years old.

Stream runoff - Timber harvest has the potential to increase peak flows in subdrainage streams, which may result in an increase in erosion of stream banks and substrate. Increases in peak flows sometimes occur where created openings have increased snow accumulation, snow pack water content, and snow pack temperature.

This effect is sometimes considered a cumulative effect, because the peakflows are a product of the cumulative total of the area clear-cut within a sub-drainage. Peak flows is dealt with as a direct and indirect effect here, because it is one component of the cumulative effects discussed below, the other two components being the effects of riparian management, and increases in sediment.

Changes in snow accumulation and melt in subdrainages (median size 2500 acres), may increased the size of peak flows during rain on snow events. Research in the H.J. Andrews Experimental Forest made comparisons between two small subdrainages, one harvested, and one forested, (Watersheds 9 and 10). When air temperatures reached 4 degrees C. and above, the peak flows from the harvested subdrainage were 50% larger than in the forested subdrainage (Harr 1986) While this analysis does not show conclusively that this is attributed to the clearcutting, it indicates that there is a high likelihood that this effect is occurring at this scale.

The relationship between timber harvest and increases in peak flows in larger watershed areas (15,000 to 100,000 acres) has been studied (Christner and Harr, 1982.) The conclusion that there appeared to be peak flows related to the amount of timber harvest is not unanimously supported in the scientific community.

Effects of increased peak flows on stream conditions - Stream conditions and turbidity are influenced by the amount and timing of water flowing through the channels. Increases in peak flows have the potential to adversely affect stream conditions and water quality by increasing the rate of movement of sediments and bedload already in the streams, and by eroding stream channels. For example, currents with velocities above 0.5 ft/sec are capable of moving silt; while flows of more than 1 ft/sec are required to move sand, and currents above 2.5 ft/second can move gravels. (Yates, 1988).

The potential effect of increased peak flows on stream channels is varied, depending on channel characteristics. Several different effects may occur within any area. For example, in low-gradient reaches, where gravels are normally deposited, increased peak flows may cause gravel-size material to move more frequently, resulting in damage to fish eggs deposited in the gravels. Vegetation may take longer to become established on the higher gravel bars, resulting in increased temperatures, and more exposed habitat. Increased movement of bedload material can influence the width and depth of the stream channel under some circumstances.

The potential effects of increased peakflows on steeper gradient streams is the increased scouring of streambeds and banks, resulting in streambank instabilities, and increased turbidity. Debris torrents may be triggered where steep channels have high amounts of gravels. The effects of debris torrents was described in the previous section.

In landtypes with deep seated mass movement adjacent to the stream channels, increases in peak flows have the potential to undercut the toe of the mass movement. In some cases the rate of movement of the unstable area may be substantially influenced by the amount of the toe material which is eroded by the stream. This process has the potential to increase turbidity and downstream bedload. This type of occurrence is limited to a few critical sites on the Forest. The potential for increases in peak flows to result in adverse effects to stream channels and water quality is related to inherent characteristics, and the beneficial use. Sensitivity of the Forests 454 subdrainages were described based on their average slope, the percent in the transient snow zone, and the local beneficial use. Average slope was selected as an indicator of the velocity of runoff, and the distance debris torrents might travel. The existing stream channel condition is important information which should be considered in assessment of the effects of peak flows on stream channels, but which was not available.

It was estimated that hydrological recovery of between 60% and 85% would maintain channel stability, depending on the subdrainage sensitivity. Each subdrainage was assigned a Midpoint ARP as a reference point for assessment purposes. During project implementation a Recommended ARP would be determined based on site specific characteristics, including existing channel conditions. The Recommended ARP can be considered a BMP to distribute timber harvest in order to minimize adverse cumulative effects. The Midpoint ARP is intended to represent an average of Recommended ARPs, used for modelling purposes.

Table IV-5 shows the theoretical hydrological recovery of subdrainages under different alternatives, with all harvest constraints applied. Many of the subdrainages would be maintained above the Midpoint ARP level because of harvest constraints from scenic and wildlife resources. In approximately one-third of the subdrainages, ARP would be the most limiting constraint. These are primarily very sensitive subdrainages where the Midpoint ARP is 75% to 85%.

Table IV-5. Subdrainage Hydrologic Recovery

	Alternatives [1]						
% Recovery	NC [2]	K	A	J	W	D	L
95-100%	NA	36	38	42	43	51	62
90-94%	NA	25	32	29	39	35	98
85-90%	NA	53	41	64	69	76	109
80-85%	NA	97	92	90	112	83	99
75-79%	NA	96	96	108	103	106	47
70-74%	NA	85	93	66	51	53	10
65-69%	NA	33	33	26	10	21	4
60-64%	NA	3	3	3	1	3	0

[1]Values presented are the number of subdrainages which fall in each category throughout the 1st decade, considering Forest and Non-National Forest land, and all land allocations
[2]No data is available. Alternative NC would be expected to cause the greatest number of subdrainages to fall into the lower 3 hydrologic recovery groupings.

At the watershed scale, the potential for adverse effects from peak flows was assessed based on an aggregation of the subdrainage Midpoint ARP levels. A comparison was made of the number of acres theoretically available for harvest in each subdrainage while meeting Midpoint ARP, with the number of acres scheduled for harvest by FORPLAN in each watershed. Table IV-6 indicates which watersheds would have the Midpoint ARP levels exceeded in all subdrainages, if the acres scheduled by FORPLAN were harvested. The Midpoint ARP levels would be exceeded by 1 to 12%. Where the Midpoint ARP levels are exceeded, there is a higher risk that stream channels and beneficial uses would not be protected.

FORPLAN results showed that harvest could be distributed to the less sensitive watersheds. The DEIS assumed that harvest would be distributed equally across watersheds, resulting in more of the sensitive watersheds being assessed as higher risk. In the FEIS analysis, FORPLAN may have been able to distribute the same amount of acres across watersheds to result in even less risk than is indicated here, however due to limitations on model size this was not feasible at this time.

Alternative K has 3 watersheds totalling 7% of the Forest in an increased risk of peak flows. Alternatives A, J, and D have approximately the same number of watersheds, but which cover less area of the Forest. Alternative L has one watershed at which does not meet Midpoint ARPs, and this is less than 1% of the Forest. All the watersheds in Alternative W meet the Midpoint ARP levels because this was one of the objectives of the Alternative.

Table IV-6. Watersheds at Risk of Peak Streamflow Increase

		Alternatives [1]						
District	**Watershed Name**	**NC [2]**	**K**	**A**	**J**	**W**	**D**	**L**
Detroit	Little N. Santiam	NA						
	Detroit Tributaries	NA						
	Blowout	NA						
	Lower N. Santiam	NA						
	Upper N. Santiam	NA						
	Breitenbush	NA						
Sweet Home	Quartville	NA	X	X			X	
	Middle Santiam	NA						
	South Santiam	NA						
	Calapooia/Wiley	NA	X	X			X	X
	Canyon	NA						
	Hackleman	NA						
McKenzie	Deer	NA						
	Scott	NA					X	
	Lower Horse Creek	NA						
	Upper Horse	NA						
	Upper McKenzie	NA						
	Wilderness Lakes	NA						
Blue River	Blue River	NA			X			
	Lookout	NA						
	Lower McKenzie	NA			X			
	Quartz Creek	NA						
	S.F. McKenzie	NA						
Lowell	Fall Creek	NA	X					
	Winberry Creek	NA						
	MF Willam Tributaries	NA						
Oakridge	Lower NFMF Willamette	NA						
	Upper NFMF Willamette	NA						
	Salmon Creek	NA						
	Salt Creek	NA						
Rigdon	Hills Creek	NA					X	
	Lower MF Willamette	NA						
	Upper MF Willamette	NA						

[1]"X" indicates that the watershed has a high risk of experiencing increased peak streamflows as a result of activity planned under the alternative.
[2]No information is available. Alternative NC would be expected to cause a greater number of watersheds to experience a high risk of increased peak streamflow and landslide incidence then Alternative B-Departure, due to having a greater amount of timber harvest and road construction.

Subsurface runoff - Timber harvest has the potential to alter the amount and timing of water entering the soil, with subsequent indirect effect on several watershed processes.

Mass movement - Snowmelt in created openings has the potential to result in increased mass movements due to increased subsurface soil moisture during rain-on-snow events.

Research on mass movements confirms that soil moisture is one factor influencing the rate at which mass movements occur. The influence of these factors such as root strength, soil shear strength, and slope, is also important. Theoretically increases in the subsurface water during the periods of rapid snowmelt and runoff could result in increases in mass movements on potentially highly unstable slopes. The risk of this occurring has been described with the ARP method by some hydrologists. The scientific community is not unanimous in their agreement that hydrological recovery of a watershed is the appropriate tool for describing the risk of mass movements, or that control of hydrological recovery will effectively control the frequency and size of mass movements.

Where mass movements occur in clearcuts, it is difficult to ascertain whether the movement is in response to increased soil moisture, or to decreased root strength. Where root strength is a factor, mitigation measures to maintain root strength on specific site can be prescribed. Very little research is available on the proportion of mass movements which are initiated by increases in subsurface water alone, without the influence of decreased root strength.

In this analysis the risk of increased mass movement is evaluated based on the landtypes where the activity occurs, as described in the section above on Sediment.

Aquifer recharge - Timber harvest has the potential to reduce summer low flows, and aquifer recharge during summer months.

Research studies indicate timber harvesting generally increases annual water yields. This is due primarily to reduced evapotranspiration. Harr (1983) developed a regression equation for use in estimating potential increases in annual water yield, which can be expected from clearcutting in western Oregon and Washington based on research results in experimental watersheds. Initial on-site increases of up to 20 inches are predicted, though they completely disappear in about 27 years. The equation predicts a smaller annual water yield increase when annual precipitation is less. Harr estimated that sustained increases in annual water yield from most large watersheds in western Oregon and Washington subject to sustained yield forest management are, at best, three to six percent more than flows from an undisturbed forest. Kattelmann, et al. (1983), estimated similar maximum potential increases in Sierra Nevada watersheds if minimum standards for all applicable laws were followed. However, they concluded that the typical increase in a large watershed drops to approximately one percent when constraints are imposed to meet other resource demands. A similar scenario is expected in Region Six National Forests due to multiple use considerations. Other factors which further minimize potentials to effect changes in streamflow are high natural variability, flow measurement accuracy is within five percent at best (so potential changes are less than what is measurable in large watersheds), and most of the flow increases occur when it is needed the least or is unusable (during spring runoff on the eastside and during fall storms on the westside.)

Research generally shows increases in summer flow result on-site immediately after harvest in western Oregon. However, studies in the Rocky Mountains (Troendle, 1983) showed no change in late summer streamflow following timber harvest, despite annual increases. (These increases occurred during spring snowmelt.) In large watersheds subject to sustained yield harvesting, summer flow increases are temporary and not expected to be measurable at downstream locations.

Effects of harvesting timber on groundwater recharge and aquifers are similar to effects on streamflow, except for timing differences; eg., aquifer responses are typically slower and fluctuate less than streamflow.

The above-mentioned research findings indicate timber harvesting on a sustained yield basis, as is presently practiced and would be practiced under any selected forest plan alternative, is expected to have a negligible, unmeasurable effect on downstream aquifers. There is no realistic potential to modify timber harvesting to measurably increase downstream water supplies. This assumes management practices are conducted in a manner which reasonably maintains water infiltration characteristics, as is typical of current practices on National Forest System lands. BMPs would ensure adequate infiltration characteristics are maintained. Only if extensive, contiguous areas were compacted would infiltration be expected to be reduced so as to adversely effect downstream aquifers.

Road interception - Road construction has the potential to increase the rate at which subsurface water reaches stream channels.

Road construction has the potential to alter natural drainage patterns, causing an increase in the interception of subsurface flows and acceleration of the delivery of subsurface runoff to the small stream channels. (Megahan) These effects most frequently occur in areas with high intensity precipitation and dissected topography.

As subsurface flows are delivered to stream channels, they may increase the flow within channels, having the same effect as described for increases in peak flows due to rapid snow melt. These effects can be compounded during rain-on-snow events in the transient snow zone, when rapid melt of snow accumulated in the road opening may reach the stream channel.

The extent to which this occurs would increase with the miles of roads constructed and timber harvested in the transient snow zone being highest in Alternative K, and A, and lowest in Alternative L and W. BMPs for road design can be effective in providing "relief" culverts, which drain water from ditches before it reaches the streams. These relief culverts, or cross-drains, direct the flow onto the slope below the road, where it infiltrates into the soil.

Runoff Summary - Timber harvesting and road building can have potential effects on patterns of snowmelt, stream runoff, and subsurface water levels, with indirect effects on stream channels. Alternatives which harvest the most acres generally have a higher risk of adverse effects from changes in runoff patterns. Alternative K results in 7% of the Forest area being at a hydrological recovery level with a risk of damaging stream channels.

Water composition

Water on the Forest contains very low concentrations of most chemicals, nutrients, bacteria, and other micro-organisms. Waters of the McKenzie River, Little North Santiam River and of Waldo Lake are widely known for their clarity and purity. Future Forest activities have the potential to change this water quality. To protect beneficial uses numerical water quality standards have been established for Dissolved Oxygen, Ph, and fecal coliform. In additions the State water quality standards prohibit bacterial pollution, fungi, tastes and odors which are deleterious to beneficial users. Numerical standards for some chemicals have been established by EPA for drinking water.

Timber Management - Changes in the chemical concentrations of water have the potential to occur where timber harvest occurs, where fertilizers are applied, and where chemicals are used for vegetation or pest control.

Research has shown that removal of forest trees sometimes results in changes to the chemical composition of water flowing from the area. Studies on the Umpqua N.F., just south of this Forest, found that clearcutting resulted in increases in total dissolved nitrogen (N) from a watershed that had been 77% clearcut, but that at no time did the increased chemical levels degrade water quality, even under the relatively strict drinking water criteria of EPA. (Adams and Stack, Draft, 1989).

Other increases from the clear-cut watershed were observed in ortho-phosphate, total dissolved phosphorus, calcium and potassium concentrations. No effect of beneficial uses has been observed from these increases.

All alternatives propose to fertilize Douglas-fir stands with urea fertilizer annually, when the stands are approximately 30 years old. The potential for fertilizer application to adversely affect water quality has been monitored during the past 10 years on a number of projects. When applied with BMPs, including avoidance of applying it to streams with beneficial uses, the increases in nitrogen would have no known effect on beneficial users.

Other timber management projects which may include use of chemicals is the management of competing and unwanted vegetation. Current direction states that the preferred methods of treatment of competing vegetation is prevention and non-herbicide tools; and that herbicides will be used only when other methods are ineffective or will increase project cost unreasonably. (FEIS Unwanted and Competing Vegetation, and Mediated Agreement.)

Chemicals such as fertilizers, pesticides, and petroleum products can reach streams through accidental spills, particularly along the railroad and major highways which bisect the Forest. Contaminants may also reach streams due to application to areas which contribute surface runoff to streams. Mitigation practices on the Forest include a Willamette N.F. Spill Plan, and existing laws and regulations. Herbicides, in particular, are not applied in the riparian areas adjacent to perennial streams. The chemical composition of water is not expected to vary by alternative.

Recreational Use - Intensive recreation use may increase levels of bacteria and nutrients, and chemicals in waters. In many cases one type of beneficial use may create risks of damage to other types of beneficial users. Recreation programs will be managed with BMPs.

Many recreation activities are located on or near streams, lakes, and reservoirs of the Forest. These activities include no-trace dispersed camping, use of livestock for pack animals, use of developed campgrounds, fishing, stream and lake swimming, use of motorized boats on lakes, and ORV use in reservoir draw-down zones. Designation of Wild and Scenic Rivers usually increases national attention and recreation use. Increased demand for water related activities is expected in all alternatives.

Uses such as dispersed camping, river running and camping, and swimming increase the risk of water being contaminated by human and animal wastes, bacteria, viruses and parasites which people carry. Gastrointestinal illness and skin diseases have the potential to increase from drinking and swimming in contaminated water. The magnitude of contamination and effect on users is not known, but experience on other heavily used recreation rivers suggest that crowding of recreationists would be noticed before water contamination is recognized as a problem. Effects would be greatest in late summer when water is relatively warmer and recreation users increase. Use of chemicals, such as detergents, increases the risk of contaminating lakes where water is not highly aerated and is infrequently replaced.

Concentration of wildlife, livestock, and saddle or packstock can have local effects on the sanitary quality of water. All of the Alternatives have similar chances of concentrating animals near streams or lakes.

Developed campgrounds are designed with measures to control water contamination, and water quality of water supplies for these campground are checked frequently in compliance with the Safe Drinking Water Act. The risk of water contamination increases where developed campgrounds do not have water supplies, and users are more likely to use local streams and lakes for their water needs.

Motorized boats are currently allowed on Waldo Lake, Big Lake, and reservoirs. The potential exists for accidental contamination, such as fuel spills on these waters. The decision to allow or prohibit this type of use is made at the District level, based on public input and environmental assessment

Reservoirs are heavily used for recreation throughout the year, for both fishing, and in some locations, for Off-Road Vechicles (ORV) use in the draw-down zone. ORV use has the potential to decreased the recovery of vegetation on the shallow parts of the draw-down zone (less than 30 feet below high water line.)

Water Yield - Quantity

Forest management practices have the potential to change the quantity of water flowing from the forest.

Watershed research consistently shows temporary increases (5-20 years) in total annual water yield and summer flow from completely deforested land (Harr 1976, 1982). Removal of trees reduces transpiration (the use of soil water by plants) and more water is available for streamflow. Increased water yield is considered a benefit when water supply is limited. Harvest areas, however, combine with undisturbed and reforested areas in large (40 square miles and greater) watersheds to mask streamflow increases. Harr, Fredriksen, and Rothacher (1979) maintain that water yield increases from sustained timber harvest would be smaller than the 5% accuracy of streamflow measurement. Harr (1976) used data from previous research to show that this would be true even when 20% of large watersheds were harvested continuously each decade. Timing of increases further reduce their benefits. None of the alternatives exceed 20% harvest per decade in drainages larger than 40 square miles, and no significant increases in water yield are expected. Chapter III, Water includes a discussion of water supply.

Potential Cumulative Effects

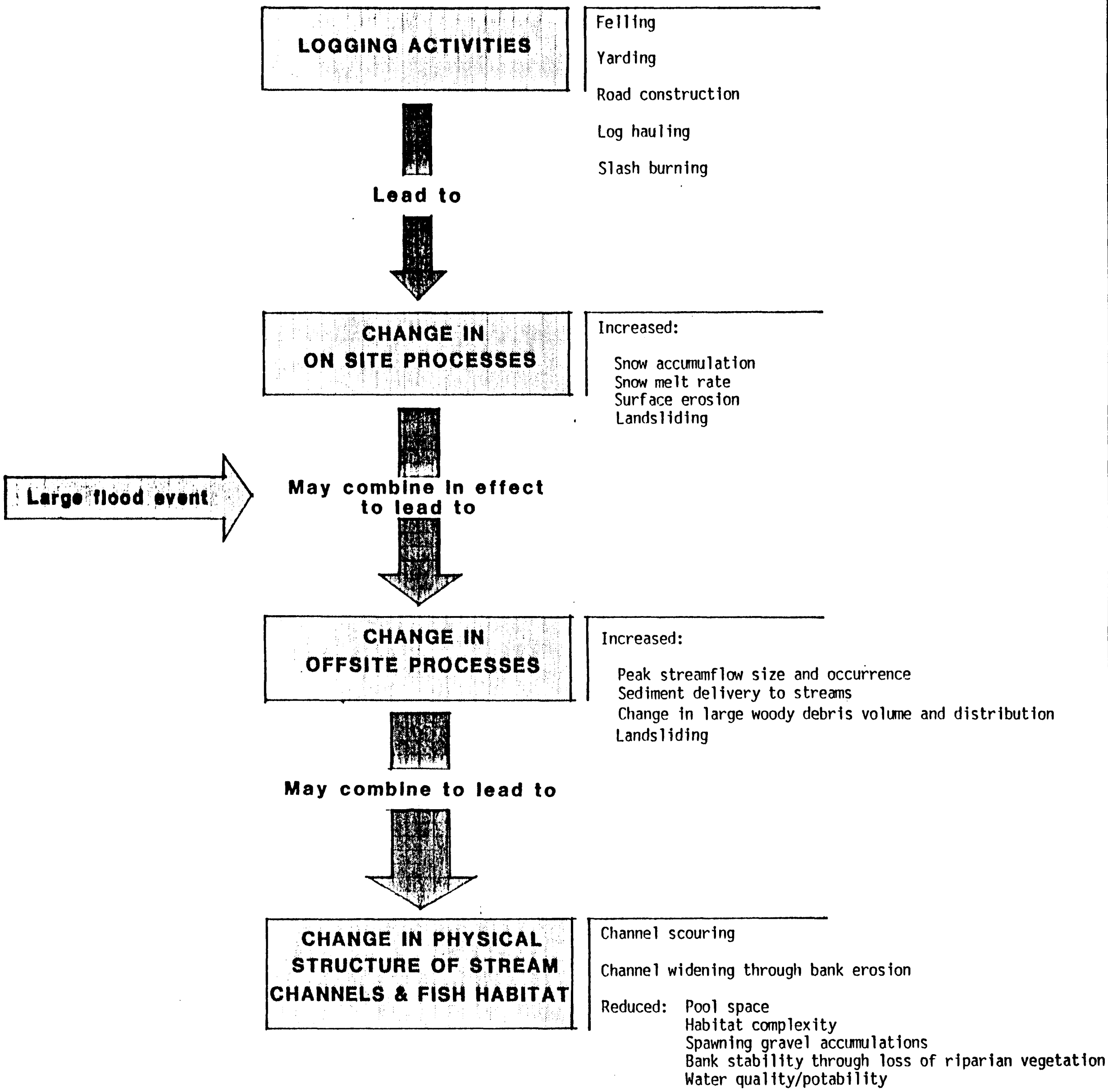
Concepts - The National Environmental Policy Act (NEPA) requires that the Forest avoid "unintended consequences" as a result of land management activities and to be appropriately conservative where knowledge is imperfect. Our knowledge in terms of assessing cumulative effects is limited. There is no consensus within the research community that cumulative effects on water occur or can be demonstrated (Grant 1986). The "state of the art" in assessing the risk or reality of cumulative effects on water is in an infant stage. Techniques for assessing cumulative effects are currently being developed by the scientific community.

The cumulative effects concept is based on the idea that individually minor actions may have additive impacts when viewed on a watershed scale. In this case, changes in riparian conditions, rates of sediment input, and peak flows may not by themselves result in adverse effects, but the changes when considered together, would influence the risk of adverse cumulative effects.

The cumulative effects concept is also based on the assumption that some impacts associated with management activities can be imperceptible for many years and then become of consequence when a large precipitation and flood event act on the altered watershed condition (Grant 1984, Lyons and Beschta 1983). Projecting effects into the future assumes a similar sequence and magnitude of flood events as has occurred in the past. An important assumption is that current channel condition, erosion levels, and hydrologic recovery can be used to predict the continuation of existing effects, or the likelihood of a watershed to experience effects in the future.

Figure IV-2 displays a theoretical linkage of management activities to cumulative, downstream effects on water quality, physical stream characteristics and functions and the fish populations which depend on aquatic resources.

Figure IV-2. Thoretical Linkages to Cumulative Effects



[1]Adapted from Grant 1984 and Grant 1986, "The Management Induced Disturbance System."

Types of Cumulative Effects - Cumulative effects occur over time, across geographical areas, and between several physical processes. In this analysis the potential cumulative effects of past, present, and reasonably foreseeable practices on all land ownerships within the forest boundaries are considered. The cumulative effects of changes in riparian condition, sediment inputs, and runoff patterns are considered on two different scales, the subdrainage scale, and the watershed scale.

There is a low risk of cumulative effects to water composition that are not related to sediment. Effects to water composition which do occur are likely to be direct or indirect effects.

Because of the complex interaction of the physical processes, the potential cumulative effects may become manifest in a number of different ways.

Alternatives which heighten the risk of peak streamflows and landsliding, with lowered inputs of LWM to provide energy dissipation and stream channel stability, may to varying degrees, aggravate existing bank instability and sediment deposition.

Low-gradient streams such as Salmon Creek, parts of the Breitenbush River, the Middle Santiam, and the Middle Fork Willamette may begin to meander or braid more due to changes in the amounts of gravel they transport, changes in flow patterns, and changes in the amounts of LWM. Channel changes, may have subsequent effects on the loss of productive riparian areas, and the quality of aquatic habitat.

Some streams like Fall, Winberry, and Hills Creek have bedrock dominated channels. Increased peak flows and landsliding would likely produce higher suspended sediment and turbidity loads, and reduce the stability of large woody debris. There may be an increase in channels scouring down to bedrock, resulting in a loss of fish habitat.

In watersheds with a high risk of cumulative effects Fish hatcheries and potable water users downstream may be required to increase the amount of water treatment, or limit their use to fewer nonturbid periods. Increases in turbidity may occur from the cumulative increases of debris torrents and channel scour.

Risk Categories - The assessment of the risk of cumulative effects for all watersheds shown in Table IV-8 is based on the combined direct and indirect effects of changes to inputs of LWM, inputs of sediment, and increases in peak flows. Within the harvest constraints and allocations proposed by each alternative, the effects have been minimized by assuming that timber harvest would be distributed according to the sensitivity of the watersheds.

Each watershed is assigned a risk rating of "High", "Moderate" or "Low", to indicate the relative risk of adverse effects. The assignment of risk is applied in Appendix B. A watershed with a High rating would still be expected to support existing beneficial uses, but the amount and relative long term stability of those uses would be lessened. A substantial number of subdrainages within the watershed would be expected to experience a management-induced decline in beneficial use levels if a 10 to 20 year (or larger) rain-on-snow flood event occurs. A watershed receives a Moderate rating if it is anticipated that a management induced reduction in beneficial uses would occur in a small number of subdrainages as result of a 10-20 year (or larger) rain-on-snow flood event. An Low rating is assigned where planned activities represent a low risk to water resources.

Table IV-7. Cumulative Effects Assessment [1]

			Alternatives						
District	Watershed Name	Percent of Forest	NC [2]	K	A	J	W	D	L
Detroit	Little N. Santiam	2	NA	L	L	H	L	L	L
	Detroit Tributaries	2	NA	L	M	L	L	L	L
	Blowout	2	NA	M	L	L	L	M	L
	Lower N. Santiam	2	NA	L	M	L	L	L	L
	Upper N. Santiam	3	NA	L	L	L	L	L	L
	Breitenbush	3	NA	M	M	H	L	L	L
Sweet Home	Quartville	2	NA	H	H	M	L	H	L
	Middle Santiam	2	NA	M	M	M	L	L	L
	South Santiam	4	NA	M	H	M	L	L	L
	Calapooia/Wiley	1	NA	H	H	L	L	H	L
	Canyon	2	NA	M	L	L	L	M	L
	Hackleman	2	NA	L	L	M	L	M	L
McKenzie	Deer	2	NA	M	L	L	L	L	L
	Scott	2	NA	L	L	L	L	H	L
	Lower Horse Creek	1	NA	M	M	H	L	L	L
	Upper Horse	4	NA	L	L	L	L	L	L
	Upper McKenzie	7	NA	L	L	L	L	L	L
	Wilderness Lakes	1	NA	L	L	L	L	L	L
Blue River	Blue River	2	NA	H	H	H	L	L	L
	Lookout	1	NA	L	L	L	L	L	L
	Lower McKenzie	1	NA	H	H	H	L	L	L
	Quartz Creek	1	NA	M	H	H	L	L	L
	S.F. McKenzie	6	NA	L	L	L	L	L	L
Lowell	Fall Creek	4	NA	H	L	L	L	H	L
	Winberry Creek	1	NA	M	M	L	L	L	L
	MF Willam Tributaries	3	H	H	H	L	M	L	L
Oakridge	Lower NFMF Willamette	5	NA	H	H	H	L	L	L
	Upper NFMF Willamette	4	NA	H	H	H	L	L	L
	Salmon Creek	5	NA	H	H	L	L	M	L
	Salt Creek	4	NA	L	M	L	L	L	L
Rigdon	Hills Creek	2	NA	M	L	L	L	H	L
	Lower MF Willamette	6	NA	H	H	M	L	L	L
	Upper MF Willamette	6	NA	M	M	L	L	L	L

[1]First decade, National Forest and private land . Risk of adverse watershed impact: H = High; M = Moderate; L = Low.

[2]NA = Data Not Available; could not be reasonably estimated since the NC Alternative (No Change) is based on a significantly different set of assumptions than the other alternatives and could not be modeled with the current Willamette National Forest FORPLAN model. The effects under this alternative would be expected to be greater than Alternative K.

Effects of Non-National Forest Lands - Harvest plans for the next decade for non-National Forest landowners within the Forest boundary have been estimated for calculation of the current and future hydrologic recovery of these lands. No attempt was made to project hydrologic recovery beyond the first decade or to estimate erosion yields from other ownerships.

The effects of private land outside the Forest Boundary was considered, but not quantified. Several alternatives propose activities which constitute a low risk within the Forest. These alternatives would not add to the risk off-forest appreciably. In most watersheds the rate of off-Forest timber harvest in the next few decades would be less than historic levels. Consequently, hydrologic recovery would increase while the rate of road construction and landsliding should decline, resulting in a diminishing sediment yield in major rivers off Forest over time.

Distribution of harvest areas and road construction within major drainages is not subject to Standards and Guidelines on non-Federal lands, and management practices can vary between Federal agencies. Forest project plans would consider activities of others within major watersheds and subdrainages during cumulative effects analyses, and mitigate the effects of increased peak flow and sediment mainly by dispersion of activity. Mitigation would be more difficult where activities on non-National Forest lands vary the most from the assumptions used in this chapter. In those cases, peak flows and sediment yields may increase, with the same effects described earlier. There is little opportunity to reduce water temperature, or improve water yield or chemical composition of water of National Forest streams in order to offset changes which might occur on adjacent lands. For example, providing more than existing effective shade on National Forest streams would not reduce water temperature.

Dispersed harvest on Forest land with intermingled non-National Forest ownerships is expected to help reduce the environmental effects of all alternatives on peak flows, sediment, and fish habitat.

Cumulative Effects Summary - In summary, Alternatives NC, followed by A and K represents the greatest short term risk of cumulative effects to watershed resources, with 29% of the Forest in High Risk category due to the greatest harvest of potentially unstable soils, riparian management at minimum levels, and low emphasis on stream Class IV protection. Alternative J results in less risk, followed by Alternative D. Alternatives L and W represent the lowest risk of cumulative effects to watershed resources. The percent of the Forest in each category is shown in Table IV-8.

The degree of uncertainty which exists in predicting cumulative effects in the short-term, is amplified greatly when projecting to the fifth decade. By the fifth decade, erosion levels in most Alternatives is approximately equal to or less than that for Alternative D in the first decade. In addition, by the fifth decade, the proportion of timber volume coming from clearcut harvest in the transient snow zone would be reduced. Consequently, hydrologic recovery levels would increase.

Table IV-8. Cumulative Effects Summary

	Alternatives						
Risk Category [2]	**NC** [3]	**K**	**A**	**J**	**W**	**D**	**L**
High %	NA	29	29	18	0	12	0
Moderate %	NA	27	25	17	0	10	0
Low %	NA	44	47	65	100	78	100

[1]National Forest and private land.
[2]Values presented are the percent of the Forest in in each category in the 1st decade.
[3]Data is not available. Alternative NC would be expected to produce greater effects than Alternative B-Departure.

Mitigation Measures for Water

Mitigation of the potential effects are summarized in the following sections. Mitigation measures would be used to avoid or repair direct, indirect, and cumulative effects already discussed.

Mitigations used to meet water quality objectives usually fall into the category of Best Management Practices (BMPs). An agreement between the Forest Service and Oregon Department of Environmental Quality establishes the use of (BMPs) by National Forests as the means to control nonpoint sources of pollution from silvicultural activities. The agreement is authorized under the Federal Clean Water Act (Public Law 92-500 as amended). Best Management Practices would be selected and tailored for site-specific conditions to arrive at project level BMP's for the protection of water quality. See BMP Appendix H for a discussion of specific BMPs, and the implementation process.

Some of the mitigations below are discussed in terms of "Effectiveness". Evaluation of BMP effectiveness is part of the format described for BMPs in Appendix H. This appendix includes criteria used to describing the effectiveness of the BMPs as High, Moderate, or Low.

Mitigation in Riparian Areas - Measures to mitigate potential increases in stream temperatures include implementation of timber harvest prescriptions which would not remove excessive amounts of shade; and to revegetate riparian areas with rapidly growing hardwood species to provide additional shade in a minimum amount of time. On larger streams, it is important that taller conifer species are also established in order to shade streams from mid-day sun.

Measures to minimize direct disturbances to stream channels would require use of yarding equipment which is capable of providing adequate suspension of logs over the streambanks. Measures to minimize streambank disturbance during road construction are to select stream crossing sites which require only small cut and fill slopes, to design road crossings perpendicular to the stream, and require equipment which is capable of moving around the site without excessive disturbance. The potential for streambank erosion following culvert placement would be mitigated by ensuring site characteristics are considered, and by using material to stabilize streambanks where needed.

All alternatives also propose to replace LWM in order to rehabilitate stream condition and aquatic habitat degraded by past practices, and where operation of heavy equipment is feasible. The rehabilitation practice of placing LWM is most successful in streams with low gradients, and watershed areas of less than 50,000 acres. This mitigation would be implemented in approximately 15% of Class I and II streams, and could not be accomplished in less than a decade. This is a relatively new practice. Its long term effectiveness is still being evaluated.

Actions in floodplains and wetlands are required to minimize impacts to those areas, under Executive Orders 11988 and 11990. Where adverse effects are anticipated, they must be formally declared with notification to the public.

Executives Order No. 11988 requires that the agency take action "to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains.

Executive Order No. 11990 requires that the agency take action "to minimize the destruction, loss or degradation of wetlands, and to preserve and enhance the natural and beneficial values of wetlands."

In addition to the legal direction concerning floodplains and wetlands, riparian areas and fish habitat are protected through reduced harvest entry, directional falling for protection of streams, and maintenance of the current amount and future supply of stable large woody debris in streams. These practices have been found to be necessary and effective in the maintenance of stream functions, fish habitat, and the productivity of the aquatic ecosystem (Keller and Talley 1979; Brown 1972; Harmon et al. 1986; Martin et al. 1981). When catastrophic events occur, or when preventative measures have failed, riparian areas adjacent to fishery (Class I and II) and nonfishery streams would be rehabilitated. Common measures are the planting of grass and tree species with rapid growth characteristics to regain bank stability, shade and reduce erosion. Streams are rehabilitated or improved by introducing boulders, gabions, or large woody debris to increase long-term channel stability and fish habitat. Accumulations of woody debris limiting access to upstream areas for fish, threatening improvements, or excessively degrading water quality, would be removed.

Mitigation of Sediment - The potential to increase the occurrence of debris torrents can be mitigated by retaining the root strength of live trees in areas of potentially highly unstable sites as identified during project planning in the field. The area and number of trees to be retained would be based on a prescription which considers the interaction of root strength with soil type, geologic characteristics, the role of groundwater and other influencing factors. These prescriptions should be more conservative when potentially unstable areas are in close proximity to a stream, wetland, lake, or reservoir. Alternatives which propose specific measures which would be highly effective are Alternatives W, and L. The other alternatives propose measures that provide a lower probability of effectiveness.

Mitigation measures used to minimize the rate at which debris slides occur from harvest units and from roads range from measures that have a high probability of effectiveness to those that have a low probability of effectiveness. Measures to mitigate the potential for increases in the rate at which debris torrents travel through Class III and IV streams to Class I and II streams also have a range of effectiveness.

The frequency of debris torrents moving down steep, headwater stream channels, can be mitigated by requiring retention of LWM in headwater channels. This includes maintaining existing instream wood along Class III and IV streams, and provisions to ensure the future recruitment of LWM along potentially highly unstable, and moderately stable Class IV streams. Maintaining the near background levels of LWM in these streams would maintains the current rate at which debris torrents reach Class I and II streams. This measure is required and modelled in alternatives W, and L.

The potential for increases in debris slides and torrents from new roads would be mitigated with measures commonly recognized as Best Management Practices. These practices include selection of stabile of road locations; design of appropriate road widths and compaction standards; installation of special drainage structures where needed; ensuring ditches, stream crossing culverts, and "cross-drain" culverts are maintained. It is estimated that these practices can improve the stability of the roads by 80%

when compared to roads constructed between the early 1960's and the mid-1970's with most of the increase due to increased compaction requirements for fills, and by ending sidecasting practices. Improvements in road construction BMPs are required in all alternatives.

The potential debris torrents from existing roads would be mitigated by stabilizing road fills, either through pulling back the uncompacted material, improving drainage around the fills, and providing additional surface stabilization where appropriate. These projects are costly, but effective, and are required in all alternatives.

Mitigation of surface erosion from slopes is accomplished by measures which retain or replace soil cover. During timber harvest the type of yarding systems, and the fuel reduction practices used can make large differences in the amount of soil cover removed. The potential for surface soils to be transported to streams can be mitigated to negligible levels by ensuring that streamside ground vegetation and woody material is maintained.

Numerous methods to provide stable road surfaces are available, and more are being developed. Practices such as asphalt paving are very effective. Less expensive materials are also available to provide stable surfacing during the months when the road is being used for haul. The use of low-pressure tires on trucks can provide substantial reductions in the amount of sediment generated from road surfaces. The use of contract clauses to restrict the season of haul is also an option for any project, where road conditions and proximity to streams would create turbidity in excess of State Water Quality standards.

Introduction of sediment from the road system is an important effect to mitigate. Roads are made more erosion resistant by addition of surfacing rock. Erosive sites are mulched, fertilized, and seeded with grass species. Ways to reduce the amount of surface erosion and risk of landsliding associated with road construction include: spacing, sizing, and location of drainage culverts; stabilizing cut and fill slopes; inspecting and cleaning ditches and culverts; building full bench roads and eliminating side cast waste where slopes exceed 55%.

Mitigation of changes in runoff patterns - There are few measures to mitigate the increases in rates of snow accumulation and melt in clear-cuts, and its subsequent effects. The most direct method is to control the rate at which clearcuts are created within an area influencing a stream channel. This has been done in the past, and would continue to be done, using the analysis method of Aggregate Recovery Percent (ARP). ARP is a tool to assess the hydrological recovery of an area. Hydrological recovery refers to the recovery of the vegetation's ability to intercept warm winds and rains during warm rain-on-snow events. This mitigation measure is discussed in additional detail under the section on Evaluation of Runoff Patterns, in the Direct and Indirect Effects Section. This practice is considered a BMP to respond to the potential for adverse cumulative effects.

Measures to mitigate the potential for increased stream flows to increase stream scouring and down-cutting stream channels is to maintain historic amounts of large wood within the channel. Up to 80% of the stream energy is dissipated while passing over log steps. (Keller and Swanson, 1979). This level of mitigation does not reduce the risk of increases in stream channel scour during increased peak flows when compared with natural conditions, but would not add additional risk of channel erosion. Where past practices have removed wood from streams, the increased peak flows have potential to decrease stream channel stability.

Many design techniques are available to mitigate potential adverse effects of road runnoff. These designs are commonly implemented BMPs, and include the use of frequent cross drains between stream crossings to disperse runoff which has collected in the ditch before it reaches the stream.

Professional knowledge of current conditions, subdrainage sensitivity, and hydrologic recovery would be used to minimize the risk of negative consequences by dispersing harvest activities to the subdrainages in the best condition. In some instances, subdrainages would be scheduled for some harvest entry, for the express reason of collecting Knutson-Vandenberg funds (generated from timber sale receipts) for the purpose of rehabilitating and improving problem areas.

Planning at the project level is the most appropriate for a focused cumulative effects analysis and site-specific design of mitigation measures and Best Management Practices. The attributes and relative sensitivity of areas within the subdrainage would be analyzed for cumulative or direct effects from past management and projected to options for future management based on the most current knowledge, management direction and desired condition of aquatic resources. Through the use of an interdisciplinary process, trade-offs between management options and relative risk of effects would be assessed. As a result, a site-specific reasoned decision which best meets multiple-use goals and mitigates or avoids direct or cumulative effects would be implemented.

Mitigation of changes to water composition - Potential changes to water chemistry which have adverse effects on beneficial uses are limited primarily to accidental spills of material. The Forest maintains a Spill Incident Response Plan, to deal with these situations. Efforts would be taken during projects such as application of fertilizer to minimize the risk of adverse spills of this material.

Measures identified in the FEIS for "Unwanted and Competing Vegetation" and the Mediated Agreement would be applied during projects of this type.

Mitigation of Cumulative Effects - Mitigation of direct effects is the primary method of ensuring that cumulative effects do not have significant impacts. The practice of dispersing harvest activities over time and throughout the landscape (Christner 1982; Rice 1980) is one means of mitigating some of the direct, indirect, and cumulative effects. According to Rice (1980) any other approach "cannot be supported by current knowledge concerning the propagation of flow or sediment in steep, rough, natural channels."

Monitoring of Mitigations - Monitoring would be the principal means by which the Forest would assess whether the Standards and Guidelines are being implemented as prescribed, as well as if the results of that implementation are producing the desired and predicted effects. The implementation of the S&Gs would be monitored through activity reviews and water quality monitoring of unusual or innovative projects. Water temperature would be monitored through long-term trend stations.
A major focus of the monitoring effort for water resources would center on testing the accuracy of the assumptions driving the cumulative effects assessment. A major assumption was that current channel condition, erosion levels, and hydrologic recovery could be used to predict the continuation of existing effects, or the likelihood of a watershed to experience effects in the future. By testing the assumptions, more effective and efficient mitigation measures can be used.

Relationships With Other Agency Plans or Policies for Water

Implementation of the State Water Quality Management Plan on lands administered by the U.S. Department of Agriculture--Forest Service (USDA Forest Service) is described in a Memorandum of Understanding (MOU) between the Oregon Department of Environmental Quality (DEQ) and USDA Forest Service (2/79)), and "Attachment A" referred to in the MOU (Implementation Plan for Water Quality Planning on National Forest lands in the Pacific Northwest 1978). This MOU and plan provide the basis for the interagency agreement, whereby the Governor of the State designates the Forest Service as the implementing agency for nonpoint source pollution control on lands under its jurisdiction.

This agreement has been updated with a Memorandum of Agreement (MOA) 1990, between the DEQ and USDA Forest Service, pursuant to Section 319 of the Clean Water Act.

The 1979 agreement provides for annual meetings between Region 6 and the DEQ to evaluate the program and progress being made and provides the basis for recertification by the Governor. Available monitoring information is reviewed, revisions, or additions to the best management practices are addressed, progress on problem identification and treatment is provided, and reports are written and submitted by the State to the Environmental Protection Agency (EPA).

In compliance with Section 319 of the Clean Water Act DEQ has issued the "Oregon Clean Water Strategy" to provide a strategic management plan for the prevention and correction of non-point source water quality problems. The Forest would work with DEQ to resolve the water quality status of waters on the Forest.

The Alternative development has been coordinated with the Basin Plans of the Oregon Water Resources Commission for the use and control of the water. The commission has restricted use of the water in most of the major streams and all of the tributaries, and most of the natural lakes on the Forest, to recreation, instream and low consumption uses. In addition the Commission has established minimum perennial streamflows in proximity to the Forest Boundary on many of the rivers flowing off the Forest. Streams within nearly all of the Forest contributes to the flows at these points, although many of the flows are controlled by reservoir dams.

Incomplete or Unavailable Information

Assess the relationships between rain on snow events, the hydrological recovery concept, peak flows, and channel stability.

Determine the amount, sizes and characteristics of timber in riparian areas needed to provide for in-stream large woody debris recruitement.

Improve knowledge of interaction of riparian conditions, peak flows and increases in sediment on water quality and channel stability.

Improve understanding of baseline stream and lake water quality and channel conditions in areas with differing geology and use patterns.

Determine cumulative effects of forest fertilization on water quality in reservoirs and lakes.

Improve information on effectiveness of road stabilization measures.

Improve understanding of effectiveness of protection of Class IV and headwall areas.

Improve understanding of influence of rain-on snow events on mass movements.

Environmental Consequences Of The Alternatives On Air

Clean air is a renewable resource, and the management of the airshed is a responsibility of all Federal natural resource managers. The Clean Air Act, as amended in 1977, directs Federal agencies to comply with State and local regulations directed at preventing and controlling air pollution.

Visibility is the air quality parameter most sensitive to management activities on the Forest. Studies are currently being conducted regarding visibility impairment and air quality impacts, Region-wide. Data from one study indicates that the suspended particulates in smoke from forest slash burning and agricultural field burning cause the greatest impacts during visibility impairment periods (DEQ 1985).

While smoke and haze detract from a Forest user's visual and recreational experience as it pertains to vistas, panoramic views and the expectation of fresh air, no emissions from forestry burning have yet been identified by the Environmental Protection Agency (EPA) as hazardous to human health, and no threshold limit has been set for compounds in Forest smoke (Sandburg et al. 1979). However, in residential areas smoke from wood stoves is becoming a health concern as more people are using wood for home heating. This smoke combines with other urban pollution sources and contributes to periods of air quality degradation in the Willamette Valley. Forest smoke can have a cumulative impact on air quality in urban areas when it occurs in conjunction with periods of cold weather that result in high use levels of firewood. In addition, firewood use is an air quality concern for the Forest because the Forest is one of the major sources of firewood for adjacent communities.

Although the "scrubbing effect" of the westerly winds improves air quality in the Willamette Valley and along the western edge of the Forest, smoke and haze is then directed toward other sensitive areas. Mt. Jefferson, Three Sisters, Diamond Peak, and Mt. Washington Wildernesses are mandatory Class I Federal areas protected from air quality degradation by law. Other sensitive areas adjacent to the Forest include Salem, Springfield, Eugene and other cities in the Willamette Valley. Communities within the Forest and east of the Cascade Crest, such as Bend, where recreation and tourism are important, have also expressed increasing concern about air quality. (See Chapter III, Air, for an airshed map.)

Direct and Indirect Effects of the Alternatives on Air

Pollution sources that affect the airshed of the Forest come from a number of causes. Forest management activities that affect the airshed include slash burning, dust and vehicular emissions from travel on Forest roads, and the use of chemicals for the control of insects, diseases and vegetation. Off forest emissions sources include pollutants from vehicles and factories; smoke from slash burning by private landowners and other land management agencies; smoke from agricultural burning; herbicide and pesticide use; and airborne dust from unvegetated areas and farm lands.

Wildfires also have a high potential to impact air quality. Unlike prescribed fire, frequency of wildfire, the amount of emissions, direction and dispersal of smoke, and duration of smoke inundation cannot be predicted or controlled. Increased use of the Forest for recreation and project activities increases the potential for human caused wildfires, thus the frequency of adverse effects to air quality from wildfire could increase.

The increased use of wood for home heating and industrial hog fuel also contributes to air pollution. During the winter months and periods of air inversions this is becoming increasingly evident in communities within and adjacent to the Forest.

Forest management activities such as road construction, road maintenance, and commercial traffic on the roads results in localized reduction in air quality due to increased particulates in the air, primarily in the form of dust.

Prescribed burning and Potential for Wildfire - Of the Forest management activities, prescribed burning has the greatest impact on the air quality. Historically, air quality impacts have been directly proportional to the amount of timber harvest. As timber harvest activities increased, so did burning. Primary consideration was the elimination of fuels on the units and reduction of residual vegetation which competes with conifer seedlings. Alternative NC has the highest harvest rate, and air quality is a greater concern, with harvest and air quality problems decreasing in K, A, J, W (PA), D and L, respectively.

The effects on air quality from wood smoke are measured in particulate matter less than 10 microns (PM-10). Emission rates for the Forest are based on projections of the amount of final harvest acres to be treated by prescribed burning, research on slash consumption and the amount of PM-10 in the resulting smoke. PM-10 emissions vary with the wood source being burned. Douglas fir generates 23.12 pounds of PM-10/tom of wood consumed. Mixed conifer has 20.53 lb. PM-10/ton of wood burned. Depending on both site specific conditions and efforts to reduce smoke emissions, not all final harvest acres will necessarily be treated by prescribed burning.

Alternatives NC, K, and A would produce the highest levels of PM-10 emissions annually as a result of high harvest levels and emphasis on maximum harvest of old-growth and mature Douglas fir which would require high treatment levels. Annual emission levels are lowest in Alternatives D, W (PA), and L. Emissions would be reduced in Alternative W (PA), even on lands intensively managed for timber production because of increased concern for ecosystem function and vegetation diversity.

Based on timber harvest levels, Figure IV-5-1 displays the average number of acres that could be treated annually by prescribed burning. Depending on site specific fuel loadings, efforts to reduce smoke emissions, and resource objectives all of acres may not be treated.

Implementation of Alternatives NC, A, J, and W (PA) would result in a higher potential for wildfire occurrence. Activities associated with these alternatives would cause approximately 22 to 53 general Forest and recreation use fires and 8 to 10 fires related to timber harvest or industrial operations. In addition, 10 to 14 wildfires resulting from escaped prescribed burns would be expected to occur annually. These fires would result in an estimated annual burned acreage from 437 to 609 acres.

Firewood Availability and Use - Management of forest residue by the Forest to provide firewood for public consumption indirectly results in reduction in air quality in local communities and major urban areas. Reducing the amount of firewood coming from Forest land, may not improve overall air quality due to increased use of alternative fuel sources, increased efficiency of wood stoves, and availability of firewood from lands in other ownerships.

Availability of firewood is directly related to the timber harvest levels on the Forest. Alternative NC will have the greatest availability of firewood, with Alternative L having the least. Demand for firewood is not expected to exceed availability through on and off Forest sources under any of the alternatives, but access to the available gathering areas may not be as convenient in the alternative with the lower harvest levels.

Smoke from wood stoves creates air quality impacts in the more populated areas off Forest. Wood stove emissions are becoming an increasing health concern and, as of July 1, 1986, state law requires stringent emission controls on all wood burning stoves sold within the state of Oregon. It is estimated that the use of firewood for home heating produces about 72 pounds of PM-10 emissions per cord burned (Lane Regional Air Pollution Authority 1986). While it is difficult to predict both local demand for and consumption of firewood, every 10,000 cords of firewood supplied to the public would generate approximately 360 tons of PM-10 emissions when burned.

Commercial use of wood products to fuel industrial plants results in increased utilization of forest residues. The direct effect of the Forest's emphasis on increasing utilization would indirectly affect air quality in industrialized areas off the Forest. Wood chips used as hog fuel would be expected to produce similar amounts of PM-10 emissions per unit of measure as firewood, though industrial emission control devices will filter out much of this matter.

Cumulative Effects on Air

The Council on Environmental Quality (CEQ) regulations require that all Federal agencies consider cumulative impacts in environmental analysis. Analysis includes impacts associated with actions "regardless of what agency (Federal or non-Federal) or person undertakes such actions" (40 CFR 1508.7). To assess the influence of cumulative effects it is necessary to model the "cause-effect" relationship between emissions and atmospheric response. This is accomplished by monitoring burning activity, transport winds, and the resultant impacts. While several methods of modeling and monitoring impacts on the airshed exist, few, if any, have provided quantitative evaluation of the actual impacts on the environment.

In all proposed alternatives, harvest levels and public concern indicate that future use of prescribed burning on the Forest would be lower than current levels.

Wildfires are not generally thought to be a major contributing source of cumulative effects associated with particulate emissions. Although site specific cause and effect relationships have not been well defined in the past, visibility and atmospheric conditions are currently being monitored by the State of Oregon Department of Environmental Quality (DEQ). This study may establish baseline data useful for future evaluation of environmental impacts.

A decrease in available firewood from the Forest is not expected to result in a major decrease in firewood use, as demand would shift to alternative sources. Although the demand for firewood may remain high, the availability of firewood from both private and Federal lands could decrease in the future. It is doubtful that the timber harvest levels predicted in the alternatives would cause the demand for firewood to exceed the potential supply. Increasing availability of firewood by reducing slash burning could compensate for losses associated with decreased timber harvest in some areas. Even with the implementation of Oregon's 1986 woodstove law, it is expected that woodstoves will still produce more air pollution than other home heating sources, although the use of more efficient clean-burning woodstoves and the burning of dry, cured firewood are expected to significantly reduce particulate emissions and subsequent impacts on air quality (Lane Regional Air Pollution Authority 1986).

Monitoring of past activity by the U.S. Forest Service, the National Park Service, the State of Oregon Department of Environmental Quality (DEQ) and local citizens groups has shown that elevation, timing and spacing of prescribed burns both on and off forest are all important factors in the management and dispersion of smoke through the airshed. Many uniform haze episodes have been a result of the cumulative effect of dispersed field and forest slash burning activity. Due to weather restrictions and other constraints, potential prescribed burning periods are extremely seasonal and concentrated, with various State, Federal and private agencies utilizing the same periods for prescribed burning. This temporarily results in a cumulative concentration of air quality problems.

The cumulative effects of Forest management activities on air quality are poorly understood. To date, no specific adverse effects of particulate emissions caused by Forest management activities have been identified by the Environmental Protection Agency (EPA) as a human health hazard.

There is growing global concern for the increasing effects of carbon dioxide and carbon monoxide emissions on the quality of the human environment. Past, present, and future burning of forest residues by industry or managers of private, State, and Federal forest lands may cause significant adverse cumulative effects to climate, including global warming. These effects cannot be addressed at a Forest level. Only the contribution of Forest management activities to the problem can be disclosed. Refer to the discussion on Climate for further information.

Mitigation Measures for Air

All of the proposed alternatives would implement the best available technology for prescribed burning to meet the following objectives:

- Manage the smoke in accordance with the Oregon Smoke Management Plan;

- Implement burning plans that are site specific to fuel conditions and are designed to achieve acceptable emission rates;

- Schedule burns to disperse smoke and minimize the impacts to the airshed.

- Utilize a number of operational measures,as specified in the standards and guidelines to minimize the potential impacts of smoke in the Forest airshed.

To manage smoke concentrations and prevent smoke intrusions into Designated and Manditory Class I areas, the Forest complies with smoke management instructions that are issued daily by the State Forester's Office in Salem. These instructions specify where and when burning is allowed and coordinate all prescribed burning activities on Federal, State and private land in western Oregon.

A reduction in the total emissions produced by the Forest will be achieved by a combination of methods including:

- Increasing the utilization of forest residues including firewood, posts, poles, chips, and hog fuel for industrial plants;

- Burning when fuel moistures are higher to reduce the amount of material consumed;

- Leaving increased amounts of standing dead and defective trees and large woody debris;

- Reducing prescribed burning as a post harvest treatment of forest residues.

When burning is prescribed to meet resource objectives, burn plans will specify optimum burning conditions. Early, aggressive, mop-up will also be used to reduce particulate emissions from the smoldering phase of a burn.

Additional fire precaution measures for industrial operations, which limit operations during periods of higher fire danger and requiring firefighting equipment at operations with the potential for fire starts, will continue as a part of the overall fire prevention program. Contract provisions specify preventative measures and the availability of additional personnel and equipment required for the prevention, early detection, and suppression of fires within the project area.

Intensified fire prevention patrols and contacts will be used to increase public awareness.

Relationships With Other Agency Plans or Policies for Air

All prescribed burning operations in western Oregon, and on the Forest will continue to be conducted in accordance with the Oregon State Smoke Management Plan (Oregon State Forestry Directive 1-1-3-410), under the direction of the State Forester's Office in Salem. On days when only limited burning is allowed, an area of potential conflict exists between the Forest, adjoining National Forests, State and other Federal land management agencies. The conflict centers around burning priorities, and who is allowed to burn. While the State Forester's Office coordinates all burning activities in the State of Oregon, resolution of scheduling conflicts is made between the local agencies involved.

Incomplete or Unavailable Information

The long term effects of emissions generated by burning wood products on global warming.

Health hazards associated with forest workers subject to high doses of suspended particulates while working on wildfires or prescribed fires.

Environmental Consequences Of The Alternatives On Climate

The climate of the Willamette Valley and western Cascade Mountains is referred to as Pacific Maritime, and has a strong influence on the vegetative patterns of the Forest. The relatively dry, cool summers and mild wet winters are particularly favorable to forests of evergreen conifers (Waring and Franklin, 1979).

Site specific microclimate conditions also play an important role in determining vegetation types, and are directly affected by land management activities.

On a global scale, forests account for about 75-80% of the carbon stored in plant biomass on the land surface, (Ajtay, et al. 1979) and play an important role in regulating the levels of carbon dioxide in the atmosphere. Whether or not global warming is occuring, and what effect it will have if it does, is cause for ongoing debate and controversy. The Forest/Atmosphere Interaction Priority Research Program (FAI-PRP) was initiated by the USDA Forest Service in FY 1990 to build upon existing research efforts and to use a complete ecosystem perspective when examining the interactions between forests and the atmosphere (USDA Forest Service, 1990)

Direct and Indirect Effects of the Alternatives on Climate

Microclimate - Timber harvest, particularly under even-aged systems, creates openings in the forest canopy that result in lower humidity, increased solar radiation, and changes in wind patterns. On a small scale, these openings become areas of climatic extremes, unbuffered by the canopy. Indirect effects of climatic extremes may lead to temporary loss or dislocation of plants or animals from the affected area.

Global Climate - Deforestation has been a source of increasing carbon dioxide in the atmosphere in the last century (Harmon, et. al., 1990). Alternatives that harvest the most timber, generally construct the most miles of road, decreasing the amount of forested land. The decrease in the first decade ranges from about 400 acres in Alternative NC to 40 acres in L. Alternatives K, A, J, W, and D will result in decreases of 275, 250, 225, 200, and 150 acres of forested land respectively. The existing road system accounts for about 24,750 acres. Most of the remaining road system will be constructed in the first decade for each of the alternatives.

The harvest of old growth releases carbon stored in plant materials and the forest floor into the atmosphere as carbon dioxide. Fast growing, intensively managed stands absorb carbon dioxide rapidly but generally lack long-term storage in dead materials and deep forest floors. Converting from an old-growth stand to a stand managed on short rotations would result in a net loss of about 150 tons/acre of stored carbon (Ibid.).

Cumulative Effects of the Alternatives on Climate

Microclimate - Alternatives that harvest more acres will maintain a proportionally larger percent of the Forest acreage in created openings at any point in time. The increased solar radiation and lower humidity will increase the risk of fire as vegetation and fuels become drier. Increased wind movement near the ground may cause higher transpiration rates, reducing soil moisture.

Global Climate - Conversion of old-growth stands to intensively managed second growth results in a net loss of stored carbon, even when considering multiple rotations (Ibid.). The magnitude of loss is estimated to be about 150 tons per acre of old growth harvested. Data is not available on the amount of old growth harvested in Alternative NC. Alternatives K and A would result in reductions of stored carbon by 8.2 and 8.1 million tons respectively, in the first decade. Alternatives J, W, and D will reduce stored carbon by 6.1, 6.6, and 6.3 million tons, with Alternative L having the least reduction at 0.5 million tons.

The total amount of carbon stored in old growth on the Forest is about 164 million tons. The first decade harvest represents a decline in stored carbon of about 5% for alternatives K and A, down to about 0.3% for Alternative L. Alternatives J, W, and D show a decline of about 3.7, 4.0, and 3.9% respectively in the amount of stored carbon. In the western Cascades of Oregon and Washington there are an estimated 4.9 million acres of old growth, with about 1.35 billion tons of stored carbon (Ibid.). The old growth harvest in alternatives K and A represent a stored carbon decline of about 0.6%. Alternatives J, W, and D represent a decline of about 0.5%, and Alternative L a decline of 0.04%.

The effects of the alternatives are not significant when compared against regional or global levels of carbon storage or acres of deforestation. However, long-term monitoring and research is needed to evaluate the effects of management activities on climate, particularly in light of the increasing concerns about global warming.

Mitigation Measures for Climate

Microclimate - Harvest systems that maintain a portion of the overstory can be used to avoid creating a harsh environment that may not be able to be regenerated within 5 years. Artificial shading, shelterwood harvest, or uneven-aged management can be used in place of clearcutting. Careful sale design and layout can also avoid potential microclimate problems.

Global Climate - On a global scale, mitigation includes increasing the amount of forested land, and reducing fossil fuel use. At the Forest level, mitigation will result from the application of some of the "New Forestry" practices. Harvest units with overstory trees left to provide attributes of old-growth habitat at an earlier age, and leaving large woody debris on the ground, will keep a greater amount of carbon in storage. Managing for a diversity of plant and animal species will allow ecosystems and plant distributions to shift as climate changes. High levels of genetic diversity will also allow species to adapt to climatic changes through natural selection.

Incomplete or Unavailable Information

As a result of increasing concerns over global warming, there is an international effort underway to determine the causes and impacts. Specific research designs and long-term monitoring are needed to detect and evaluate the effects of a changing chemical and physical environment.

Environmental Consequences Of The Alternatives On Vegetation

Vegetation on the Forest is dominated by dense stands of Douglas fir and other conifer species covering about 90% of the Forest land base. Woody shrubs and lush herbaceous plants are found in the understory of these timber stands. Interspersed within the major Forest plant communities are meadows, rock cliffs, and extensive alpine and subalpine parklands. Hardwoods such as alder, big-leaf maple, and willow generally dominate riparian areas adjacent to rivers and lakes, and wetland areas contain grasses, forbs, and sedges.

There are 21 sensitive plant species on the Forest; no plants are currently listed as threatened or endangered. These species are usually associated with plant habitats that include bogs and wet areas; rocky ridge tops and slopes; and open slopes, fields, or meadows above timberline. Any proposed activity that affects the population or distribution of sensitive plant species will be evaluated on a case by case basis to determine the extent of potential impact and level of necessary mitigation.

Plant communities and vegetative conditions change naturally. Silvicultural activities such as harvest, reforestation, release, thinning, fertilization and salvage will also affect vegetative conditions, usually at a faster pace than natural changes.

Successional stages, plant diversity, old-growth forests, timber, riparian zones and range are discussed in this section. The consequences of the alternatives on wildlife habitat, scenery, H.J. Andrews Experimental Forest, and Research Natural Areas (RNAs) are described in detail in their respective Chapter IV sections.

Direct and Indirect Effects of the Alternatives on Vegetation

Because of the Standards and Guidelines (S&Gs) that govern all Forest management activities there is little difference in the types of direct effects on vegetation among the proposed alternatives. Differences among the alternatives are generally the result of the amount, scheduling, and location of the proposed activities that remove or alter vegetation. The differences range from Alternative NC, which includes short-rotation timber management activities on about two-thirds of the Forest, to Alternative L, with a mix of long and short rotations on only one-third of the Forest.

Successional Stages

Disturbance to vegetation, whether natural or human caused, affects species composition, size, age, density, and the overall pattern of vegetative cover. Natural successional patterns are maintained in a number of areas on the Forest, which promotes vegetative diversity. Natural plant succession is most apparent in designated Wilderness, and vegetative conditions remain generally undisturbed in old-growth groves, subalpine and alpine plant communities, nonforest lands such as meadows, wetlands, and rocky cliffs, and in areas managed for semiprimitive recreation with timber harvest constraints. On these lands, disturbance to vegetation is usually the result of events such as fire, floods, or windstorms, or impacts from wildlife or recreation use. Vegetation may be altered in developed recreation sites for the safety and convenience of Forest users.

Changes in vegetation are most apparent in areas of the Forest managed intensively for timber production. During timber harvest and reforestation activities, the successional stage of a stand of trees is abruptly changed from large trees, to brush, grasses, and seedlings. (See Chapter III, Vegetation, Figure "Successional Pattern of Stand Conditions.") Trees are removed, and falling and yarding operations uproot and crush many of the understory shrubs and forbs. Harvest units may be burned to reduce logging slash and prepare sites for reforestation. While some understory vegetation is destroyed, other plants respond to these disturbances with vigorous new growth. As a result of both increased sunlight and reforestation efforts, species composition generally changes from shade tolerant to shade intolerant species.

The survival, growth, and vigor of desirable tree seedlings are enhanced by timber stand improvement activities. These activities include reducing brush competition, precommercial thinning, and fertilization. The scheduling of silvicultural treatments manipulates species composition, density, successional stage, and age of the stand. Methods include mechanical, manual, and biological techniques, and the use of prescribed fire and chemicals. See Appendix F for a full discussion of silvicultural practices and techniques.

The harvest level associated with each alternative will determine the amount of the Forest which will undergo abrupt changes in successional stage each decade. This will determine, not only the ultimate condition of the Forest, but the rate at which the Forest moves toward that condition. Alternative L will result in a forest that is generally older, with a greater representation and wider distribution of the later successional stages of large, older trees and accompanying understory vegetation. Alternatives J, W (PA) and D are similar to each other, but will have fewer acres in later successional stages than Alternative L. Alternatives NC, K, and A have the fastest harvest rates, and will result in a forest that is younger, overall, with less representation of the later successional stages, than the other alternatives. The faster rates of harvest will result in more fragmented distribution and declining effectiveness of habitat in the older stages.

Plant Diversity

Diversity can be discussed in terms of richness (i.e., the variety of species) and evenness (i.e., the relative population levels of each species). In forested plant communities, the early successional stages (grass/forbs) and old growth stages have the greatest diversity of plant species. (See Figure IV-3) Special and unique habitats associated with cliffs, talus, meadows, marshes, bogs, and riparian areas contribute significantly to the overall plant diversity of the Forest.

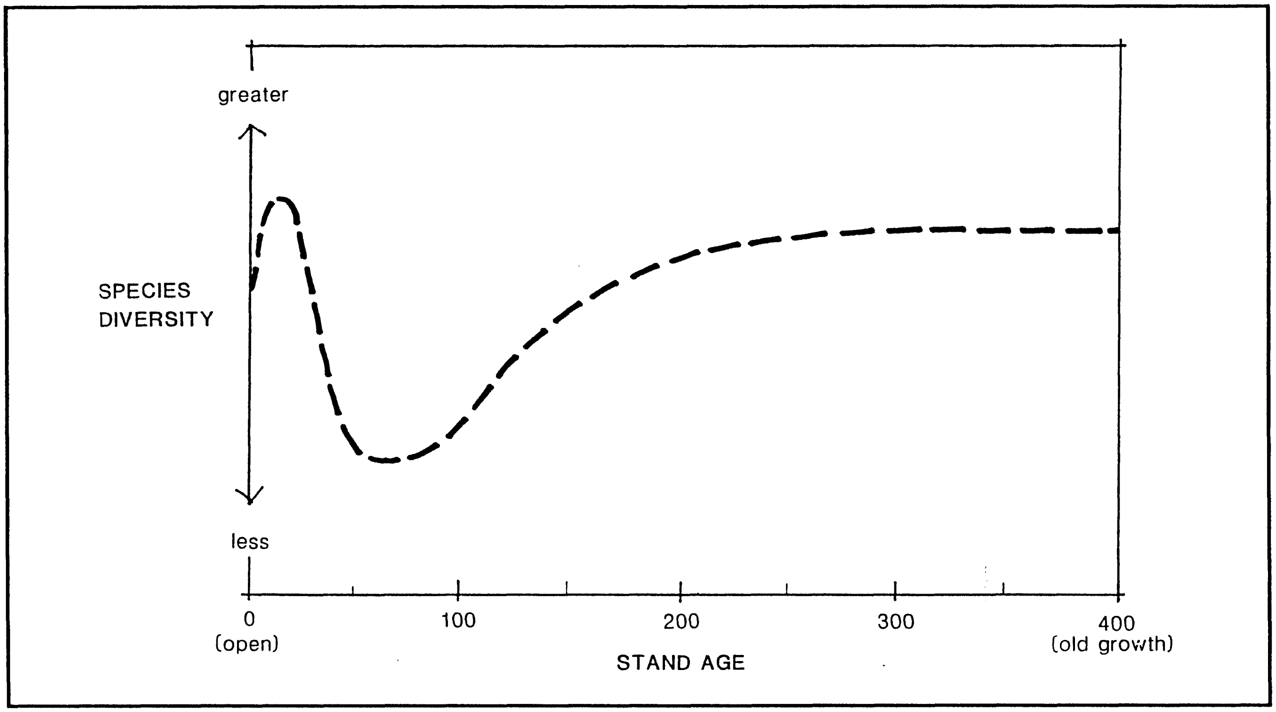
Most management activities directly affect vegetation resulting in changes to seral stage, species composition, and plant diversity. While timber harvest activities, which influence the greatest amount of area, may not affect overall species richness, they do significantly change species evenness. Alternatives NC, A, and K provide little or no protection of special and unique habitats other than T&E plants. This would cause significant disturbance and result in a high risk of losing many plant species. In addition, these alternatives propose to harvest most old growth stands, converting them to intensively managed forests which may not maintain well distributed populations of plant species endemic to the Forest. Alternatives J, W (PA), D, and L, respectively provide increasing protection for special and unique habitats and maintain old growth stands distributed throughout the Forest. Alternative L maintains most of the Forest vegetation in an unmanaged condition.

Silvicultural and vegetation management practices directly affect vegetation diversity by favoring commercial tree species like Douglas fir over hardwood trees and minor conifer species. Vegetation management activities involving the use of herbicides significantly reduce the diversity of broad-leaved forbs, shrubs, and trees in early seral forests. Prescribed fire directly affects plant diversity by consuming existing vegetation and could eliminate fire-sensitive species. Aggressive non-native plants commonly invade burned areas.

Recreation use can adversely impact plant species growing in sensitive environments. Areas receiving heavy use by hikers and campers could be damaged resulting in a loss of plant diversity from trampling, soil compaction, or development of campsites.

Habitat enhancement activities involving the establishment of preferred forage plants could directly affect the establishment and seral development of native plants.

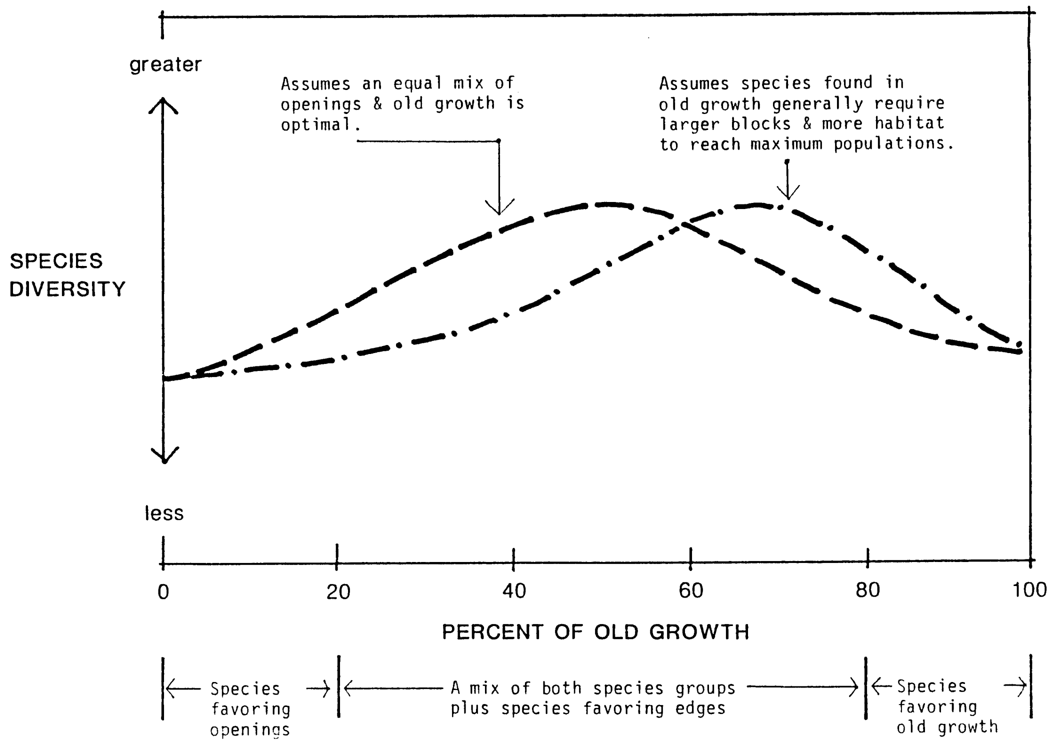
Figure IV-3. Diversity by Stand Age



From a Forest-wide standpoint, the greatest diversity would occur with a mix of old growth and forest openings. This would provide habitat for species adapted to old growth as well as those adapted to openings, second growth, and edge habitat. Figure IV-4 shows two assumptions regarding the optimal mix of old growth and openings. One line shows the relationship of species diversity and the amount of old growth with the assumption that the greatest diversity occurs when their is an equal mix of old growth and openings. The other line assumes that species adapted to old-growth conditions require larger blocks and more habitat to reach maximum populations and that the ideal amount of old growth would be more than 50%. In either case, substantially reducing the amount of old growth could reduce overall species diversity, particularly evenness.

The current condition of the Forest has about 40% of the forested lands in the old growth successional stage. At the end of the first decade, there is little difference between the alternatives (NC at 33% to L at 38%) as to the amount of forested lands remaining in old growth. After five decades the differences are more apparent. Alternative L provides the best balance between successional stages, maintaining about 35% of the forested lands in old growth. Alternatives D and W (PA) maintain 24%, and Alternatives J, A, and K are at 23, 22, and 20% respectively. Alternative NC will provide the least balance between successional stages, maintaining about 17% of the forested lands in old growth.

Figure IV-4. Forest-wide Diversity



Old-Growth Forests

One stage of natural vegetative succession that is not duplicated in stands managed intensively for timber production is old growth. Old growth is characterized by multi-layered canopies, large old trees, standing snags, and large logs in streams and on the Forest floor. The values associated with old-growth timber relate to its importance for wildlife habitat, scenic qualities, clean water, awe-inspiring recreational and spiritual qualities, maintaining diversity of the gene pool for future stands, supplying timber of exceptional quality and value, and providing a living connection with the past.

There are currently about 594,800 acres of old-growth trees on the Forest that meet the Pacific Northwest Region definition of old growth (see Regional Guide). Of the total old-growth forest, 78% is low elevation Douglas fir/hemlock. The higher elevation types are found in the following proportions: Douglas fir/true fir and true fir combined is 16%; and mountain hemlock/lodgepole pine is 6%.

The major effect on old growth will be through the sale and harvest of timber, which causes a sudden change from old growth to the grass/forb successional stage. Most of the area harvested will be managed with a rotation length shorter than the time necessary to reach a similar old-growth stage. The size, shape, and arrangement of old-growth stands affect their integrity as habitat for plants and animals. Harvest activities will reduce the size, increase the amount of edge, and fragment the old-growth stands allocated to timber yield. Effective old-growth habitat in these areas will be substantially less than the actual acres of old growth (Hemstrom 1986). Figure IV-5 shows the relationship of effective old-growth habitat and stand size. As the size of old-growth stands are reduced through timber harvest, the effectiveness of the habitat begins to decline at a much faster rate than the decline of actual old-growth acres.

Figure IV-5. Effective Old-Growth Habitat

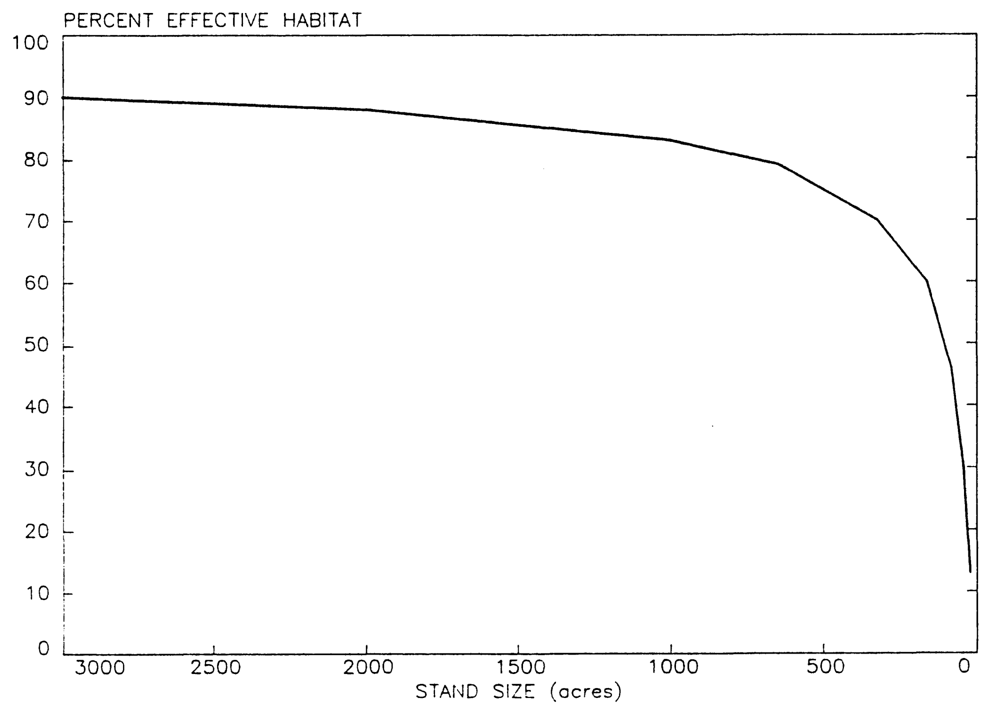


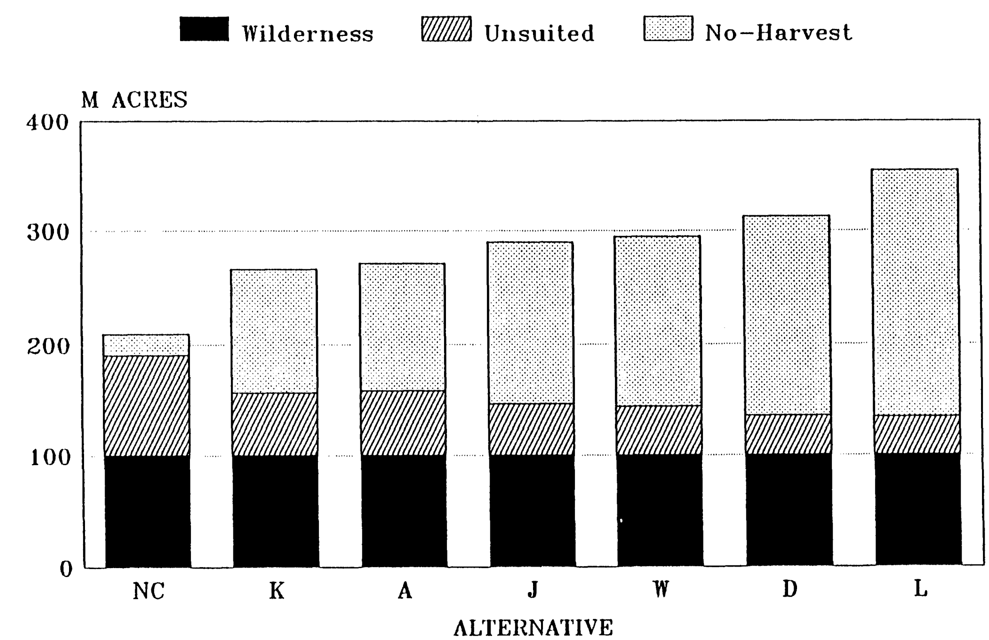
Figure IV-6 shows the distribution of old growth on the Forest at the present time, by no-harvest allocations and land unsuited for timber production. Also shown are the acres of old growth available for some level of timber harvest.

Alternative L, which sets aside 419,500 acres of old growth, retains 71% of the current total. Alternatives D, W (PA), and J retain 53, 50, and 49% respectively, followed by A and K at 46 and 45%. Alternative NC has the least amount set aside, with 35% of the current 594,800 acres of old growth.

Table IV-8 shows the acres of old growth at the end of decades 1, 2, and 5. Also shown is the total of forested acres that will not be harvested for each alternative. In the absence of natural disturbances, these figures represent the potential amount of old growth as the smaller size classes gradually move through the successional stages over time.

Alternative L maintains the greatest amount of old growth at the end of five decades (523,100 acres). With fewer acres harvested per year, there will also be a slower decline in the effectiveness of the old-growth habitat. Alternatives D and W (PA) maintain about 30% fewer acres. However, Alternative D will result in greater fragmentation and fewer acres of effective old-growth habitat than W (PA), because it harvests old growth at the same rate as W (PA), but on a smaller land base. Alternatives J, A, K, and NC drop to 35, 36, 42 and 50% less than the acres in L. From Alternative L to NC, (with the exception of Alternative W (PA)) there is a corresponding increase in the annual harvest of old growth and a proportional increase in the rate of decline in effective old-growth habitat. The gap between acres of old growth and acres of effective old-growth habitat widens from Alternative L through Alternative NC.

Figure IV-6. Old growth by Allocation



		Alternatives						
Allocation	**Unit of Measure**	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Wilderness Unsuited No-Harvest[1]	M Acres M Acres M Acres	100.8 89.9 19.3	100.8 56.5 109.2	100.8 58.2 112.4	100.8 45.9 143.6	100.8 43.5 150.6	100.8 35.1 177.1	165.4 33.8 220.3
TOTAL [2]	M Acres	210.0	266.5	271.4	290.3	294.9	313.0	419.5
Timber Harvest	M Acres	384.8	328.3	323.4	304.5	299.9	281.8	175.3
Current TOTAL	M Acres	594.8	594.8	594.8	594.8	594.8	594.8	594.8

[1]No-harvest allocations can include semiprimitive nonmotorized, riparian, special wildlife habitat, Special Interest Areas, and MRs.
[2]This figure displays the minimum amount of old growth that could be maintained over the planning horizon (150 years) by alternative. None of the alternatives actually reach this minimum level due to in-growth.

Table IV-9 Old-Growth Acres Over Time

	Alternatives [1]						
	NC [2]	K	A	J	W	D	L
Decade 1 (M Ac.)	494.0	522.4	528.4	534.9	533.4	537.2	578.3
Decade 2 (M Ac.)	NA	449.7	460.9	473.6	479.1	478.4	558.1
Decade 5 (M Ac.)	259.8	305.1	337.0	341.4	365.2	367.8	523.1
Decade 15+ (M Ac)	440.1	571.7	630.2	651.1	729.9	785.1	951.4

[1]Acres of old-growth timber, in all allocations, remaining at the end of each decade. Decade 15+ values show potential old growth on forested no-harvest allocations, assuming no catastrophic events.

[2]NA = Data Not Available; could not be reasonably estimated, or compared to other alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other alternatives, and could not be modeled with the current Forest FORPLAN model. Appendix B of the FEIS describes these differences.

Timber

With the reduction of uncontrolled wildfire, timber management activities have become the major cause of ecosystem disturbance on the Forest. Silvicultural activities are aimed at establishing and tending timber stands and at harvesting wood products from the Forest. These include site preparation, reforestation, timber stand improvement, commercial thinning, and final harvest. Most silvicultural practices on the Forest are implemented with the intent to perpetuate the growth and development of even-aged stands of timber.

A specific amount of timber harvest is proposed in all alternatives. The magnitude of the effects of the alternatives on the timber resource depend on three basic factors. The most important of these is the number of acres suited for timber production. The other factors are the intensity of management and rate of harvest. These factors determine the amount of volume to be offered for sale during the plan and the level of harvest that can be sustained in the long-term.

Effects on Suited Acres - Figure IV-10 shows the comparison of lands suited for timber production by alternative and percent of full yield. For all alternatives except NC, there are 1,032,138 acres on the Forest that are tentatively suitable for timber management. (See Chapter III, Timber.) Removal of 85,513 acres for management requirements (MRs) leaves a potential land base for timber management of about 946,625 acres. Alternative NC with different suitability standards and no consideration of MRs, exceeds this potential by 12% (1,064,616 acres). Alternatives K, A, and J schedule harvest on 99, 92 and 90% of this potential respectively. Alternatives W (PA) and D are in the medium range with 82 and 76%, and Alternative L schedules harvest on 58% of the potential land base for timber management.

Table IV-10. Comparison of Suited Timberlands

					Timber Yield Acres with Yield Reductions to Meet Other Resource Objectives					
Alternative	**Acres with Timber Yield**	**% of Tent. Suited -MRs[1]**	**No Yield**	**% of Tent. Suited - MRs**	**Acres of Full Yield [2]**	**%**	**75-94% Full Yield**	**%**	**50%-74% Full Yield**	**%**
NC (No Change) [3]	1,064,616	112%	0	0	918,657	86%	54,000	5%	91,959	9%
K	932,813	99%	13,992	1%	796,974	85%	70,306	8%	65,533	7%
A	874,291	92%	72,514	8%	743,451	85%	71,236	8%	59,604	7%
J	853,398	90%	93,407	10%	719,610	84%	72,556	9%	61,232	7%
W	774,608	82%	172,197	18%	689,229	89%	42,870	6%	42,509	5%
D	719,439	76%	227,366	24%	638,929	89%	40,425	6%	40,085	5%
L	553,090	58%	393,715	42%	314,299	57%	74,857	14%	163,938[4]	29%
Rotation Age					60-110 years		140 years		200 years	

[1] Suited acres minus MRs = Total Forest acres (1,675,407) - nonforest acres (146,153) - withdrawn acres (327,501) - roads and unsuited acres (169,615) = 1,032,138 acres tentatively suited - acres required for resource management objectives (36 CFR 219.14 (c)) which preclude timber production (85,513) = 946,625 acres.
[2] Full yield is that developed in a yield simulator, less operational falldown, without further reductions for other resource considerations, and available for harvest at CMAI (or 95% CMAI).
[3] Alternative NC has the same land allocations as Alternative A (No Action) but is based on different land suitability standards and does not include MRs. It also assumes the necessary budget, workforce and technology will be available to produce full timber yields from 125,000 acres of "marginal" land.
[4] This table includes 74,941 acres that are managed on rotations of 330 to 660 years, with timber outputs that are less than 50% of full yield.

The timber volumes produced are a direct result of, and follow the same trend as, the number of acres managed. Table IV-11 shows volume by harvest method for the alternatives. The alternatives that produce the most timber volume are NC, K, and A which harvest 146, 117, and 110 MMCF per year in the first decade, respectively. Alternatives J, W (PA), and D provide moderate levels of timber at 95, 87, and 86 MMCF per year, with Alternative L producing the least amount of timber at 27 MMCF per year in the first decade.

Historically, firewood has come from a portion of the cull material associated with timber harvest and is part of the timber sale program quantity (TSPQ). The amount available for firewood use varies depending on the market for chips and cull peelers, and contract specifications for size of cull material to be removed from the harvest unit.

Because of their proposed high levels of timber harvest, Alternatives NC, K, and A would provide the most firewood, with 72, 57, and 54 thousand cords per year in the first decade. Alternatives J, W (PA) and D would provide moderate levels of firewood at 46 to 42 thousand cords and Alternative L would provide the least firewood at about 14 thousand cords per year in the first decade. Availability of firewood in all alternatives decreases over time as the harvest of older existing stands is replaced, to a great extent, by the harvest of managed stands and commercial thinning. By the fifth decade, firewood supplies are expected to decline to about 50% of the first decade levels.

Commercial thinning volume is nearly equal in the first decade for all alternatives except L, because the size classes available for thinning are mostly on lands that are suited for harvest under all alternatives (Table IV-11). By the fifth decade the commercial thinning volume shows more variation, reflecting the differences in harvest levels and management intensities. Exact figures for Alternative NC are not available, but commercial thinning in the fifth decade will account for about 50% of the total volume.

The long-term sustained yield capacity (LTSYC) for each alternative is a prediction of the maximum timber volume that can be sustained annually from the tentatively suitable timber lands on the Forest consistent with the multiple use objectives of the alternative. The difference in long-term sustained yield capacities between alternatives reflects the number of acres suitable for timber management, and the intensity of timber management and rate of harvest assigned to those acres.

The long-term sustained yield capacities of the alternatives are influenced most by the number of acres suited for timber management. Alternative NC has the highest capacity at 146 MMCF because it has the most acres suited for timber management. The LTSYC of the other alternatives decrease as the amount of land considered unsuited, or allocated to non-timber or more restrictive timber uses increases. (See Tables IV-10 and IV-11.)

For all alternatives, except NC, LTSYC is greater than beginning harvest levels (See Table IV-10). This occurs because the managed stands of the future will produce or grow more volume than the existing stands of mature timber are currently growing. In the sixth to eighth decades there will be a shortage of mature timber available for harvest because the bulk of the second growth will not have reached 95% of culmination of mean annual increment (CMAI). Application of the nondeclining yield constraint means that harvests in the earlier decades must be held below LTSYC to avoid a drop in volume in decades six to eight. Alternative NC avoids this situation by relying heavily on commercial thinning volume to offset the shortage of mature timber available for harvest in the sixth to eighth decades. As many as six thinnings, spaced ten years apart are prescribed for some stands, with the total yield from commercial thinning accounting for half or more of the volume in some decades.

Effects on Intensity of Management - Intensity of management refers to the mix of silvicultural treatments applied to the acres which are suited for timber management. The silvicultural treatments used in the alternatives include reforestation, release, precommercial thinning, fertilization, commercial thinning, and regeneration harvest. The difference between alternatives is the number of acres to which these treatments are applied. These are displayed in Figure IV-4-8. The individual treatments and their effects are described in Chapter III, Timber.

Alternative NC, K, and A harvest the most area with an average of 14,400, 12,600 and 12,100 acres per year in the first decade. Alternatives J, W (PA), and D are in the moderate range with 10,200 to 9,100 acres. Alternative L harvests the fewest number of acres at 3,300.

The other silvicultural treatments are a function of the acres harvested, accessibility, and response to fertilizer (except Alternative NC which did not include the use of fertilizer).

Historically, treatments to release seedlings from competing vegetation have been necessary on about 20% of the acres reforested. The Forest Plan incorporates the Pacific Northwest Region's FEIS for Managing Competing and Unwanted Vegetation. In implementing the Forest Plan through project activities, the Forest will comply with the Record of Decision issued by the Regional Forester dated December 8, 1988, and the Mediated Agreement of May, 1989. Use of all vegetation management techniques is allowed only when other methods are ineffective or will unreasonably increase project costs. Emphasis must be on prevention and early treatment of unwanted vegetation and full public involvement in all aspects of project planning and implementation.

Table IV-11 Annual Volume of Commercial Thinning and Final Harvest

		Alternatives						
	Net Volume	NC	K	A	J	W	D	L
1st Decade								
Total	MMCF	146	117	110	95	87	86	27
Final Harvest	MMCF	140	112	105	91	83	82	26.8
Commercial Thin	MMCF	6	5	5	4	4	4	0.2
% Total	%	4%	4%	5%	4%	5%	5%	1%
5th Decade								
Total	MMCF	146	117	110	95	87	86	27
Final Harvest	MMCF	NA[1]	113	108	80	77	77	20
Commercial Thin	MMCF	NA	4	2	15	10	9	7
% Total	%	NA	3%	2%	16%	11%	10%	36%
LTSYC [1]	MMCF	146.0	120.0	113.5	107.8	94.7	93.8	34.2

[1] LTSYC = Long-term Sustained Yield Capacity.

[2] NA = Not Available.

Table IV-12 Annual Silvicultural Treatments (M acres)

Treatment	Decade	NC	K	A	J	W	D	L
		Alternatives						
Regeneration Harvest and Reforestation	1st	14.4	12.6	12.1	10.2	9.1	9.9	3.3
	2nd	NA[1]	12.6	12.1	10.0	9.4	10.0	2.8
	5th	NA	11.8	11.6	8.2	8.1	8.5	2.3
Release	1st	2.2	2.5	2.4	2.0	1.8	2.0	0.7
	2nd	NA	2.5	2.4	2.0	1.9	2.0	0.6
	5th	NA	2.4	2.3	1.6	1.6	1.7	0.5
Precommercial Thinning	1st	10.7	8.6	9.5	6.6	6.7	7.1	1.8
	2nd	NA	11.1	10.5	8.9	7.9	8.6	2.9
	5th	NA	9.2	8.7	7.3	6.8	7.0	2.3
Fertilization	1st	0	10.2	8.8	11.8	9.6	10.2	5.6
	2nd	0	9.2	9.9	7.4	7.9	7.4	2.4
	5th	0	10.1	10.7	7.7	7.3	6.8	2.6
Commercial Thinning	1st	4.2	3.1	3.2	2.6	2.8	2.7	0.2
	2nd	NA	0.2	0.2	1.7	2.1	0.3	0.9
	5th	NA	2.8	1.3	10.1	6.8	5.5	4.9
[1] Data not available.								

Effects on Rate of Harvest - Constraints on rate of harvest are used to disperse harvest units spatially so that large openings are not created at any one point in time. The size and shape of created openings varies with resource management objectives. Harvest rate constraints are also used to distribute harvest units over a period of time (temporal) to limit the cumulative effects of timber harvest. In areas where both spatial and temporal constraints apply, the one with the most limiting rate of harvest was modeled.

Constraints on rate of harvest affect the rotation length of a timber stand. Rotation length is the number of years from the regeneration of a new stand to the time of its harvest. Generally shorter rotations (less than 110 years) are designed to increase timber production or achieve economic objectives while longer rotations (more than 140 years) are used to harvest timber while focusing on wildlife, recreation, riparian, and scenic objectives. Table IV-13 shows the range of rotation ages by species, management intensity, and constrained rates of harvest as applied to all alternatives except NC. The percent culmination of mean annual increment (CMAI) volume is also shown, to compare yield potential. Alternative NC was not analyzed with the FORPLAN model and had no constraints which applied directly to the rate of harvest. Areas like streamside zones and scenic corridors had reduced yields to simulate a longer rotation. Comparing the NC alternative to the others is difficult because the yield tables are based on a different grouping of species and site indexes.

All alternatives except NC tend to harvest the unconstrained acres at 95% CMAI to maximize present net value (PNV) and minimize the shortage of stands at rotation age in the 6th to 8th decades. Alternative NC rotation ages are at full CMAI on unconstrained acres. Table IV-10 shows the acres by yield category which can be translated into rotation ages. In this figure harvest rates of 10 and 12% are included in the full yield column while the acres with 7% and 5% harvest rates are in the 75-94% full yield and

50-74% full yield categories respectively. Percent of full yield for Alternative NC is taken directly from the current TM Plan.

Although the actual acres managed on long rotations vary substantially by alternative, they result in a fairly consistent percentage of the total timber yield acres for each alternative except L. The range is from 11% for Alternatives W (PA) and D, 14% for NC, 15% for K and A, and 16% for J. Alternative L manages 43% of the suited lands on long rotations of up to 660 years.

Table IV-13. Rotation Age

			Rotation Age[1]							
Management Intensity	**CMAI**	**95% CMAI**	**At Harvest Rate of 12% Per Decade**	**% CMAI**	**At Harvest Rate of 10% Per Decade**	**% CMAI**	**At Harvest Rate of 7% Per Decade**	**% CMAI**	**At Harvest Rate of 5% Per Decade**	**% CMAI**
Douglas-fir/Hemlock										
PCT & Fert.	67 yrs.	57 yrs.	83 yrs.	97%	100 yrs.	94%	143 yrs.	74%	200 yrs.	62%
Hvy CT & Fert.	117 yrs.	77 yrs.	83 yrs.	97%	100 yrs.	99%	143 yrs.	89%	200 yrs.	72%
FSLC & Fert.	107 yrs.	77 yrs	83 yrs.	99%	100 yrs.	100%	143 yrs.	86%	200 yrs.	71%
Douglas-fir/True Fir										
PCT Only	87 yrs.	77 yrs.	83 yrs.	100%	100 yrs.	99%	143 yrs.	85%	200 yrs.	69%
Hvy CT	117 yrs.	97 yrs.	83 yrs.	91%	100 yrs.	95%	143 yrs.	95%	200 yrs.	79%
FSLC	117 yrs.	97 yrs.	83 yrs.	93%	100 yrs.	97%	143 yrs.	93%	200 yrs.	74%
True Fir										
PCT Only	97 yrs.	77 yrs.	83 yrs.	99%	100 yrs.	100%	143 yrs.	96%	200 yrs.	87%
FSLC	97 yrs.	87 yrs.	83 yrs.	98%	100 yrs.	100%	143 yrs.	93%	200 yrs.	84%
Mountain Hemlock/ Lodgepole Pine										
PCT Only	87 yrs.	77 yrs.	83 yrs.	100%	100 yrs.	96%	143 yrs.	79%	200 yrs.	66%
FSLC	97 yrs.	87 yrs.	83 yrs.	98%	100 yrs.	100%	143 yrs.	90%	200 yrs.	75%

[1] Rotation age and percent culmination of mean annual increment (CMAI) volume are displayed by management intensity, species, and harvest rate per decade.

CMAI = Culmination of mean annual increment.
Fert. = Fertilization.
PCT = Precommercial thinning.
FSLC = Full stocking level control.
Hvy CT = FSLC with one heavy commercial thin.

Riparian Areas

Although riparian vegetation occupies only a small part of the overall acreage of the Forest, these areas provide critical diversity and stability in the forest ecosystem. In riparian corridors along streams, rivers and lakes, the presence of multiple vegetative layers provides a variety of nesting sites, cover areas and food sources for wildlife. The roots of riparian vegetation help to stabilize streambanks and adjacent slopes. Vegetative screening maintains low water temperatures by shading streams from solar radiation, and woody material provides spawning and rearing habitat for anadromous and resident fish. Riparian areas have different microclimates from the surrounding coniferous forests due to increased humidity, a higher rate of transpiration, shade and greater air movement. These conditions are preferred by some wildlife species, as well as by people participating in a variety of water oriented recreation activities during the summer months. Within riparian areas disturbance to vegetation and soils is minimized and harvest rates are reduced or eliminated in all of the proposed alternatives.

Alternatives A, J, and K prescriptions are at the MR levels designed to protect water quality and streambank stability. Alternative D allows no programmed harvest along Class I and II streams, and 5% per decade along Class III streams. Alternatives W (PA) and L have no programmed harvest along Class I, II, and III streams. The effects of these practices on water and fish resources are discussed in their respective sections elsewhere in this Chapter. Alternatives with higher rates of harvest in riparian areas will have the following effects: 1) reduced soil and channel stability, 2) reduced water quality, 3) greater fluctuation of stream flow and ground water, 4) less input of large woody material in future years, 5) greater modification of vegetative diversity, 6) reduced opportunity for quality dispersed recreation, and 7) less habitat for wildlife species, such as primary cavity excavators, optimal thermal cover for big game, and dispersal corridors for species that require interior habitat.

Table IV-14 displays riparian acres by stream class which are scheduled for timber harvest per decade. Also shown is the estimated cumulative percent of riparian harvest by alternative. The actual amount of harvest which occurs will be based on localized watershed and stream conditions. The expected pattern will be a mosaic of partial and no-cut areas from which timber yields are expected to approximate the modelled rate. This table also shows the cumulative percent harvested over five decades. The percents shown reflect the overlap of riparian areas with management areas that do not allow harvest.

Table IV-14 Riparian Harvest Acres and Cumulative Percent Harvested Rate by Stream Class [1]

	Alternatives						
Harvest	**NC [4]**	**K**	**A**	**J**	**W**	**D**	**L**
ACRES HARVESTED PER DECADE							
Riparian 1 [2]	NA	604	606	508	0	0	0
Riparian 2	NA	667	668	639	0	0	0
Riparian 3	NA	1,289	1,255	1,216	0	826	0
Lakeside							
TOTAL							
Cumulative Percent Harvested[3]							
Decade 1	NA	4%	4%	3%	0	0	0
Decade 2	NA	7%	7%	7%	0	2%	0
Decade 5	NA	18%	18%	17%	0	6%	0

[1]Stream class definitions are in Chapter III, Water.
[2]Riparian 1 refers to the zone adjacent to Class I streams, Riparian 2 along Class II streams, and so forth
[3]Percent harvested of Riparian areas of all stream classes, in all land allocations.
[4]No data is available. In the current Land Management Plan, Class I, II, and III streams were grouped together, and assigned a timber yield of 72 percent of full yield, which approximates a 5 to 7% rate per decade.

Range

The heavily forested land base has limited capacity for grazing of domestic livestock, although there has been some use of the suitable areas for grazing cattle and sheep under fee permits and some free-use grazing of recreational stock. Grazing use on National Forest land by domestic livestock has been a traditional use which has declined significantly over the past five decades. Although many of the older allotments have areas of suitable range, the reduction in the use of Forest land for range can be attributed largely to increasing labor and transportation costs without like increases in livestock returns. Examples include costs of hauling to the allotment and live stock control to keep stock on the allotment. In addition, the establishment of Wilderness has made some areas with historic grazing use unavailable to new applicants.

The effects of the alternatives on the range resource are minimal since permitted livestock use historically has been low and the large amount of forage in range allotments and transitory range is expected to far exceed anticipated demand. Although the quality of transitory range varies by habitat type and terrain, generally the alternatives that harvest more timber provide more transitory range.

Cumulative Effects of the Alternatives on Vegetation

There are approximately 123,000 acres of non-National Forest land within the forest boundary. The management of these lands will contribute to the cumulative effects on vegetation. Harvest on these lands are generally based on economic return rather than non-declining even-flow. Most of these lands have been cutover and are being managed intensively for maximum economic return. For the first two decades of the plan, these stands will be in a young, fast-growing stage of development, providing good watershed recovery, and cover for big-game, offsetting some of the impacts of harvest on National Forest lands. By about the third decade they will be ready for harvest and cutting will likely take place at a rapid pace, impacting watershed conditions and maximizing forage at the expense of thermal cover. In all but a few watersheds, the amount of non-National Forest land is a small percentage and the effects can be balanced with the management of National Forest land. In some areas, Forest management activities will be influenced by vegetative conditions on private lands.

Cumulative Effects on Succession - All alternatives must meet the S&Gs concerning percent cutover, size and dispersion of units, reforestation, and rotation age. Regeneration harvest under even-aged management will determine patterns of successional stages as timber sale plans are implemented. A greater variety of age classes will be present with stands having greater populations of shade intolerant species. Differences between alternatives are measured by how much of the Forest is affected and the rate at which the effects occur. Alternatives which allocate more acres to timber harvest will gradually result in a balanced array of successional stages between grass/forb and large mature trees on a larger part of the Forest, and a smaller share maintained in old growth. Figure IV-14 shows the difference in alternatives as to acres managed for timber yields. For a typical 100 year rotation, a balanced array of successional stages would result in the following Forest condition on the managed acres: about 5% would be grass/forb, 10% shrub, 15% open sapling/pole, 50% closed sapling/pole/ small sawtimber, and 20% large sawtimber.

The portion of the Forest in no-harvest allocations would remain in, or gradually grow into, the old-growth successional stage (barring natural disturbances such as fire, insects, disease, and windthrow). Non-National Forest lands will generally not be managed beyond the small sawtimber stage.

Cumulative Effects on Diversity - Figure IV-4 shows the relationship between the amount of old growth and the variety of species (plant and animal). At the present time, about 40% of the forested land is covered with old growth. The alternatives differ as to the ultimate balance of successional stages and the time it takes to get there. At the end of the fifth decade, the alternatives are generally at the point where Forest-wide diversity is lowest and when the amount of old growth will begin increasing as the younger age classes begin to move into the old-growth successional stage. After five decades Alternative L has the highest amount of old growth Forest-wide at about 35% of the forested land. Alternatives D and W (PA) are at 24%, followed in order by J, A, and K at 23%, 22%, and 20% respectively. Alternative NC has the lowest amount of old growth after five decades, at 17% of the forested land.

After this point in time, Forest-wide old growth amounts will begin increasing. The highest level would occur after the fifteenth decade. Alternative L has the highest potential with 63% of the forested land capable of old growth. Alternatives D and W (PA) could be at 52 and 49%, followed by J, A, and K at 43, 42 and 38%, and NC at 29%.

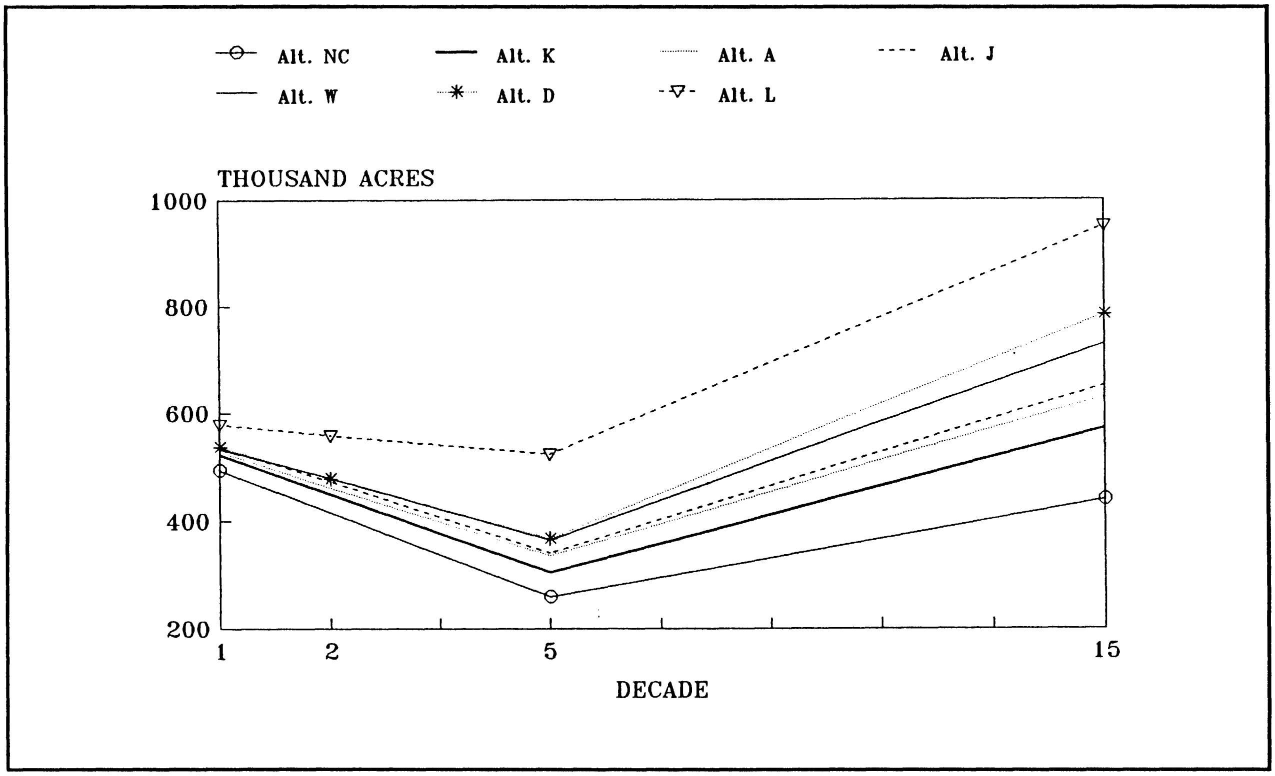
The decline in Forest-wide diversity will occur at a faster rate with alternatives that harvest more acres per decade. The old-growth habitat becomes less effective as it is broken up into small areas by harvest units, and more edges are created. The amount of effective old-growth habitat in harvest allocations will decline more rapidly than the actual acres of old-growth trees. Application of a "minimum fragmentation" strategy can delay or reduce this effect, and is an option with all alternatives where appropriate. Table IV-12 shows the difference in acres harvested for decades 1, 2, and 5.

Cumulative Effects on Old Growth - Figure IV-7 shows the amount of old growth remaining by decade for each alternative. By the end of the fifth decade most of the old growth on lands allocated to full timber yield will be gone. Management areas in retention middle ground and foreground will be maintained in a late mature or old growth stage of development, but are not specifically preserved like wilderness or Old-Growth Groves. As the harvest of old growth proceeds, the effectiveness of remaining old-growth habitat will diminish because the larger blocks of old growth will be gradually broken up by harvest units. The old growth that is set aside in each alternative is in large enough blocks to provide effective habitat on a continuous basis and will generally be connected by riparian corridors. The end of the fifth decade generally marks the low point of old growth acres for each alternative. Alternative L maintains the most old growth with about 523,100 acres. Alternative D is next with 367,800 acres, followed in order by W (PA) (365,200), J (341,400), A (337,000), K (305,100), and NC with the lowest cumulative total after five decades of 259,800 acres.

After five decades, the amount of old growth will begin rising as harvest occurs increasingly in regenerated second growth stands, and the younger age classes in no-harvest allocations gradually become old growth. The actual amount of old growth in no-harvest allocations will depend on the occurance of fire or other disturbances. After 15+ decades, Alternative L has the potential to exceed current levels of old growth with about 951,400 acres. Alternative D has a potential of 785,100 acres, followed by W (PA) (729,900 acres), J (651,100 acres), A (630,200 acres), K (571,700 acres), and NC with the least potential at 440,100 acres.

The 123,000 acres of non-National Forest lands will have little or no cumulative effect on old growth. There are less than 3,000 acres (2.5%) of old growth remaining at the present time. Most of the remaining acres that are manageable will soon be harvested. These non-National Forest lands will generally be managed on relatively short economic rotations and will not provide old growth in the future.

Figure IV-7. Old-Growth Acres



Cumulative Effects on Timber - The magnitude of the following cumulative effects will depend on the total acres managed for timber production. Table IV-9 shows the total acres with timber yields for each alternative.

In general, alternatives which harvest more acres will gradually result in younger age classes, fewer stands of old-growth, and a younger average age of timber stands in the Forest. Along with the younger ages will come smaller average tree sizes. There will be less defect and breakage as diseases found in mature and overmature trees have less chance to develop in the younger stands. The amount of acreage in age classes from 100 to 200 years will decline in the future as the majority of the managed stands will be on rotations of 60 to 100 years, and the unmanaged stands continue to age. Laminated and blackstain root rots may show some increase with intensive management, but losses can be minimized by planting and favoring resistant species and timing precommercial thinning to minimize spread of disease by insects seeking out the fresh cut stumps.

For all alternatives, the total volume of standing trees (5"+ dbh) on land allocated to timber management will be less at the end of the planning period than at the beginning. Standing volume will decline over a period of decades until a point of equilibrium is reached where growth equals harvest (decade 2-5). Per acre growth rates will be greater at the end of the planning period than at the beginning, on timber management acres, because regenerated managed stands grow at a faster rate than existing unmanaged stands.

The per acre yield of commercial products from the Forest will increase as stands are managed to maintain fast growth rates by controlling competition. Growth will also be enhanced through fertilization and genetic selection. Cross-breeding for desirable genetic traits will provide greater increases in successive generations. Care must be taken to avoid reducing genetic diversity which could make the Forest increasingly susceptible to insects and disease. All alternatives meet or exceed the requirement that the growth rate by the year 2030 be 90% of LTSYC. Concerns about maintaining long-term productivity are addressed by the S&Gs that minimize soil compaction and erosion, and maintain large woody debris within harvest units.

Future firewood supply will be dependent on the health and age of forest stands being harvested, and prescriptions for removal and piling of unmerchantable material to provide planting spots and/or reduce fuel accumulations. The availability of firewood will decrease over time with the implementation of any of the alternatives, as harvest shifts to regenerated, managed stands with less cull material.

Cumulative Effects on Riparian Areas - In the overall forest setting, riparian areas are relatively high in diversity of plant and animal species. Harvesting adjacent to these areas will change the species composition by allowing more light to reach the ground favoring the more shade-intolerant species. As harvest progresses in and adjacent to these corridors, the risk of blowdown will increase. Construction of roads associated with harvest will reduce vegetation, particularly along Class III streams where there is more area that still requires road access in order to conduct management activities.

Figure IV-9 shows the differences between alternatives as to the number of riparian acres that will eventually be harvested. The data for Alternative NC is not available. Alternatives K, A, and J are all very close with 17 to 18%, Alternative D will harvest 6% in Class 3 only, and Alternatives W (PA) and L harvest no riparian acres at all along Class I, II and III streams.

For all alternatives that harvest riparian areas along Class I and II streams, the rotation age is 200 years, which will result in large mature tree to old growth successional stages. For alternatives that harvest riparian areas along Class III streams, the rotation age is 140 years which will provide trees in the large mature successional stage.

Cumulative Effects on Range - Livestock grazing can cause surface compaction around salt blocks or watering areas, fences, loading ramp facilities, and trails. Over time, compaction alters plant composition and may even eliminate plants almost all together. In some areas, frost action tends to break up surface compaction and some of the polygonium species will establish on areas that are not severely compacted. However, if the situation occurs over too long a period or if the areas are continually overused, vegetative density and composition can change. On domestic range allotments where meadow habitat types are grazed, naturally moist meadows and other areas may receive damage if not managed to maintain desired plant species composition.

Relationships with Other Agency Plans or Policies for Vegetation

The S&Gs associated with vegetation management activities in this Plan will meet or exceed those found in the plans of other agencies.

The Forest Plan incorporates the Pacific Northwest Region's FEIS for Managing Competing and Unwanted Vegetation. In implementing the Forest Plan through project activities, the Forest will comply with the Record of Decision issued by the Regional Forester dated December 8, 1988, and the Mediated Agreement of May, 1989.

Mitigation Measures for Vegetation

A wide range of mitigation measures can be used to avoid, minimize, rectify, reduce, or compensate for undesirable environmental impacts to vegetation. These types of mitigation will not vary by alternative, although the degree to which they will be applied will be relative to the amount and location of activities which disturb or remove vegetation. Mitigation measures include the protection of the basic soils resource to maintain productivity, and protection from damage as a result of fire, insects, or disease.

Openings will not be created adjacent to any natural openings such as meadows, cliffs, caves, and talus areas, unless adequate vegetation along the edge can be developed or retained in sufficient density to protect wildlife values and visual management objectives. To minimize disturbance to natural openings, management activities will be planned in a manner sensitive to site productivity, microclimate, and special wildlife or plant habitat needs. Where practicable harvest systems, schedules, and patterns will maintain late seral stage timber in at least 30-50% of the edges of these areas, also dead and defective tree habitat is maintained when safety conditions permit.

Forest openings created by even-aged silviculture will not exceed 60 acres unless otherwise justified (36 CFR 219.27(d)). The Regional guide allows exceptions for catastrophic events (fire, insects, wind); use of logging systems to reduce damage to soil, water, and other resources; to reduce the spread of diseases (mistletoe, root rot) from adjacent stands; and to improve scenic quality by shaping and blending units to fit the land-form. The S&Gs further restrict unit sizes within some Management Areas. Sizes range from one acre maximum in the retention foreground areas to thirty acres in modification background areas. Harvest rates for these areas vary from 10% to a more limited 5% per decade.

There are a number of methods that are used to minimize impacts on vegetative diversity. These include protecting non-forested areas; planting a mix of commercial timber species to simulate natural conditions; managing noncommercial vegetation to maintain a variety of ecoclasses and successional stages; and maintaining old growth in no-harvest allocations. If Federally listed threatened or endangered plant species are identified, recovery plans will be initiated and the USDI Fish and Wildlife Service will be consulted. Timber management or other activities will be modified or eliminated to meet the requirements of the Endangered Species Act of 1973. Species classified by the State of Oregon, as being threatened or endangered, will also receive the protection necessary to insure viable populations.

A number of logging techniques are used to protect residual regeneration, forage, seed trees, or wildlife trees which could be damaged by timber harvest activities. These techniques include scheduling of activities when vegetation is less susceptible to damage; suspension of logs during skidding; skidding logs over a designated depth of snow; and designating buffer corridors. Riparian areas have different logging requirements to minimize disturbance to vegetation. In Alternative W (PA) and L, timber would not be harvested in riparian zones; the other alternatives would allow harvesting at different rates (see Table IV-9).

Riparian areas will be maintained as habitat for riparian-dependent resources. Measures include project design that maintains vegetation both vertically and horizontally, resulting in greater plant and wildlife diversity; wildlife migration routes and travel corridors; and dead and decaying tree habitat. In addition, along perennial streams the existing cover directly above the channel and within 20 vertical feet of the stream surface will be maintained at 60% or greater of the existing natural level.

Damage to vegetation as a consequence of recreation use is minimized by a number of practices. Healthy native vegetation will be maintained around campsites and the loss of trees as a result of human activity will be avoided. Vegetation at these sites will be monitored for adverse losses. The size of groups and groups with trail stock will be limited in dispersed camps. Dispersed camping areas are to be located more than 100 feet from lakes, streams, trails, and key interest features in some of the Management Areas.

Experience in mitigating potential adverse impacts on vegetation has been gained on the Forest in places such as Jefferson Park in the Mt. Jefferson Wilderness. Here in the late 1970s the vegetation was suffering from intensive use by campers. By 1980 it became the practice for Wilderness rangers to instruct campers about the need to preserve the vegetation and disperse camps away from the lakes. By dispersing camps with a 200 foot set back, vegetation began recovering. String fences were used to delineate and protect areas that were rehabilitating. Seed from native vegetation was gathered and used to rehabilitate areas damaged by concentrated use.

To regulate and monitor collection activity, and avoid potential harmful impacts a permit is required for collection of vegetative material including ferns, seedlings, bear grass, tree boughs, Christmas trees, and cascara bark. Rehabilitation projects, trail and area closures, and visitor contact can be implemented when necessary.

A wide range of activities can be used to avoid, minimize, or compensate for impacts to timber quantity and quality. The types of these measures will not vary by alternative, but the degree to which they are applied will depend on the amount and location of timber harvest. Alternative NC does not include the use of fertilizer.

Decreases in allowable harvest levels can be mitigated in two ways, by increasing the number of acres available and suited for timber management and by increasing yields from each acre. Research is ongoing to find cost-efficient methods of reforesting unsuited soils within five years of harvest. Research is aimed at providing safer and more effective ways to release trees from competition and protect them from insects, disease, and animal damage. These efforts result in earlier establishment and faster growth. Forest soil types are being tested to determine if the increased tree growth off-sets the cost of fertilizer. The genetic improvement program is moving into the next stage with the establishment of seed orchards. The present yield table uses a 10% increase in yield for using seed from superior trees in reforestation. Additional gains may be possible by further testing and cross-breeding these superior trees in seed orchards.

Higher yields may also result from new technology allowing commercial thinning over longer distances with less damage to residual trees. About two-thirds of the suited land base is accessible for thinning. New technology and more widespread use of existing techniques like directional felling can increase yields by reducing breakage and increasing utilization of wood that is presently left on site or burned to prepare the site for planting.

A range of controls is available to prevent damage to seedlings in plantations. These are found in Appendix D, General Management Standards, Vegetation Control and Integrated Pest Management. These control damaging agents such as wildlife, plant competition, disease, and insects. An example of reducing animal damage to seedlings is the use of vexar tubing placed over the tree to prevent browsing or clipping by wildlife. Burning of logging slash removes cover for hares, mountain beavers, woodrats, porcupines, and other small mammals. Burning also slows growth of vegetation for several years and lessens competition for light and moisture (Black and Hooven 1978).

The timing of these measures can be critical to their success and to minimizing their impacts. For example, slash burning must be accomplished when fuel moisture levels are dry enough to reduce slash to desired levels, but duff is wet enough to prevent the burn from becoming too hot and damaging the soil. Another example is timing precommercial thins to avoid the spread of blackstain root disease by beetles attracted to the fresh cut stumps.

Detailed silvicultural prescriptions will address environmental conditions that pose a limitation to a species that is not exclusively adapted to the conditions that are present. An example is planting a mix of species. The silvicultural prescription will also be guided by the S&Gs that will limit size of openings, harvest rates, and disturbance according to Management Area. (See Chapter IV, Vegetation.) All the various forms of even-aged regeneration cutting will be available for use including clearcutting, shelterwood, and seed tree. Where appropriate, uneven-aged management will be accomplished by group selection in some Management Area Prescriptions.

Pruning is another measure that may be used in the future to mitigate impacts on wood quality due to younger age classes and smaller tree sizes. The removal of lower branches can encourage high quality, high value clear wood not otherwise found, except in old-growth trees.

Careful design, layout, and administration of the harvest operation can increase yields by protecting site quality, reducing breakage and logging damage to residual trees, and minimizing the risk of windthrow and escaped slash fires.

Decreasing supplies of firewood in the future can be mitigated to some extent by considering non-traditional sources such as precommercial thinning and commercial thinning slash, and through small sale or salvage sale programs.

On lands that are suitable and available for domestic livestock grazing, permits and the Range Allotment Plans will distribute and limit the number of animals on each area. Range Allotment Plans are revised and updated on an annual basis. This interaction promotes the resolution of environmental issues and the anticipation of potential conflicts.

The control of noxious weeds that are toxic to livestock is achieved on the Forest without the use of chemicals. Biological forms of control are administered by the State of Oregon. Allotment Plans promote grazing rotation to reduce the amount of thistle and other pasture weeds. Mechanical pulling of undesirable vegetation may be implemented if necessary.

A number of mitigation measures can be utilized to reduce or minimize undesirable impacts to range and grazing resources. For example, salt block and watering locations are periodically moved to promote optimum grazing patterns and minimize long term animal concentrations and soil compaction. Range improvements and maintenance projects can also be utilized to prevent resource damage and to sustain the productivity of existing permits.

Environmental Consequences Of The Alternatives On Fish

Introduction

Thirty species of native and naturalized fish live in aquatic habitat within the waters found on the Forest. Although historically fish populations on the Forest have declined slightly, commercial and recreation industries are still supported in part by Forest fish resources. The management and enhancement of fish habitat by the Forest Service and the Oregon Department of Fish and Wildlife (ODFW) has had a positive correlation with recreational use and values. Fishery related businesses include those of guide services, motels, restaurants, processing plants, and of boat and equipment dealers.

Direct and Indirect Effects of Alternatives on Fish

Although all fish species are considered important, only the anadromous salmon and resident trout species are considered as management indicator species (MIS) on the Forest. These species were selected because of their value as sport and commercial fish species and because they have special habitat requirements that may be significantly influenced by management practices.

Both fish production and habitat capability are important measures of fish habitat conditions on the Forest. While many relationships between fish and their habitat are complex and not every detail is completely known or thoroughly understood, biologists do know that the ability of a species to inhabit a given environment successfully is dependent on a number of factors which ensure the basic survival and reproductive requirements of the species. These factors are water temperature within minimum and maximum tolerances, spawning gravel within size limits used by each species, adequate food supplies, and living space for protection against excessive predation and severe hydraulic events.

Anadromous Fish - The effects of proposed activities on anadromous salmonids is described with a smolt habitat capability index (SHC). This index was based on the best available information and coordination with Oregon Department of Wildlife. The Index can be adjusted as new and better information becomes available. (See Monitoring, Chapter V of the Plan.) Three major factors influence the effects of an alternative on SHC; elimination of major barriers to fish passage by other agencies; the level of enhancement projects provided by each alternative, and the level of timber harvest in and adjacent to riparian areas.

The existing SHC is estimated at approximately 169,000 smolt, from 139 miles of existing anadromous fish habitat. These numbers reflect a low number of returning chinook, to the McKenzie River, and low returns of winter steelhead to Fall Creek and the Santiam River. The potential SHC of this habitat is estimated at approximately 437,000 smolt assuming adequate adult escapement to fully seed existing freshwater habitat.

All alternatives propose to provide rehabilitation and enhancement of approximately 60 miles of the existing habitat. The full effectiveness of these projects may not be seen until the second decade when the SHC would be at over 500,000 smolt.

The elimination of major barriers to passage for spring chinook in the South Santiam, and McKenzie watersheds would add an additional 106 miles of habitat, and would improve smolt production and potential adult anadromous fish escapement in all alternatives. These projects are primarily under the jurisdiction of the Army Corps of Engineers, Oregon Department of Fish and Wildlife, and Eugene Water and Electric Board; agencies with which the Forest will work with cooperatively to increase the miles of available habitat. The completion of these projects is expected to increase smolt habitat capability by an additional 500,000 smolt the first decade. Habitat rehabilitation and enhancement projects on 30 miles of the potential habitat would increase the smolt habitat capability by almost 800,000 over existing habitat levels during the second decade. These projections also assume harvest regulations that allow sufficient adult escapement to fully stock the habitat.

In addition to instream improvements, several types of on-Forest enhancement projects would increase anadromous fish populations. These projects focus on expanding the utilization of anadromous fish habitat to presently unoccupied sites by hauling adult fish around small, on-Forest barriers such as waterfalls; and by increasing smolt production through the use of egg incubator boxes along streams.

Timber harvest within the riparian area and adjacent to the riparian areas has direct impacts to the fishery habitat. The processes which create the changes to aquatic habitat are described in more detail in the Water section of this chapter. These processes focus on changes in riparian conditions, levels of sediment, and changes in runoff patterns. The assessment of the influence of timber harvest on smolt habitat capability is based on the same three parameters.

Tree removal within the riparian areas reduces a number of important fish habitat components. When riparian trees are removed, so is the source of fine organic material which is used as food or cover for aquatic food organisms, is no longer available. The large woody material (LWM) such as limbs, boles, and root wads that interact with hydraulic forces to cause gravel sorting, scour, and ponding are no longer providing that function. Reduction of habitat diversity and productivity is reflected in the reduced fish availability.

At least one side of at least 39% of Class I, II, and III streams had already lost the stream-side vegetation, the effect will be long-lasting. Recovery of hardwood vegetation to 75% canopy closure takes approximately 25 years. Recovery of full-sized conifers may take up to two hundred years to produce future large woody debris where hardwood species have become dominant in riparian areas.

When trees in the riparian areas are harvested, there are other indirect effects to the fish habitat. Riparian areas along streams and lakes act as filter strips that trap sediment and sideslope debris from adjacent roads and harvested areas. Riparian areas become less efficient filter strips as trees are removed allowing the sediment and debris to reach adjacent streams. Excessive sediment has the potential to deposit in slow moving areas, reducing the dissolved oxygen to salmonid eggs and alevins. (Chapman and McLeod, 1987) Debris torrents and rocks can destroy fish habitat by washing out in-stream cover filling, in rearing pools, and reducing the habitat diversity within a stream. Removal of trees within the riparian areas also causes reduction in root strength and increases the risk of erosion through streambank and streambed scouring.

In the alternatives, the maximum rates of harvest per decade in riparian areas vary. Alternatives K, A, and J emphasize commodity production with low to moderate emphasis on amenity resources such as fish. The fish resource is not considered a high commodity resource and these alternatives would allow the greatest amounts of harvest in the riparian areas associated with Class I, II, and III streams. In these alternatives, a 5% harvest rate per decade is allowed in the riparian areas associated with Class I and III Streams, and a 7% rate of harvest in riparian areas associated with Class III Streams. These alternatives would allow a 10% harvest rate in lakeside riparian areas. In Alternatives K, A and J, there would be a reduction of food supply and large woody debris in the stream compared to the other alternatives.

Alternatives W (PA), D, and L have a higher emphasis on fish resources. Alternatives would allow no harvest in riparian areas associated with Class I and II areas, and 5% harvest in riparian areas associated

Class III stream areas. Alternatives W (PA) and L would allow no programmed harvest from Riparian areas adjacent to Class I, II, and III streams. These alternatives would allow no harvest in riparian areas adjacent to lakes. Food and nutrient supply levels as well as large woody debris recruitment should be higher in these three alternatives than in Alternatives K, A, J.

Table IV-15. Smolt Habitat Capability Index

	Alternatives						
	NC [1]	K	A	J	W	D	L
Smolt Produced [2] FIRST DECADE Existing Habitat Potential Habitat	 NA NA	 392 439	 397 443	 410 458	 437 488	 432 433	 437 488
TOTAL		831	840	868	925	865	925
SECOND DECADE Existing Habitat Potential Habitat	 NA NA	 616 686	 621 692	 641 716	 681 763	 674 676	 681 763
TOTAL		1302	1313	1357	1444	1350	1444

[1]NA = Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model.
[2]Thousands of smolts

Harvest levels would be less in Alternatives W (PA), D, and L than in the others which result in fewer acres being disturbed due to road building or harvesting of units. The mass wasting levels are expected to decline significantly under Alternatives W (PA) and L, which provide additional direction for protection of Class IV streams and potentially highly unstable landtypes. The risk of adverse effects from mass movement during major storm events, is discussed in the Water section. Mass movement, at rates increased above natural levels, has the potential for damage to fish, as debris fills pools, and increases levels of fine sediments in spawning substrate. First decade erosion levels are below levels in previous years based on the occurrence of normal storm events.

Alternatives W (PA), D, and L would produce the highest levels of smolt (over 560,000 smolt) from existing habitat during the first decade, while Alternatives A, K, and D would produce between 500 and 550 thousand smolt. Per decade harvest rates and smolt populations were not determined for Alternative NC. However, due to increased instream sediment loads, smolt populations are expected to be lower than population estimates in Alternative K.

Erosion in the stream would be higher in Alternatives K, A, and J, compared to the other alternatives due to increased road building at the higher elevations and head wall areas to meet the objective of higher harvest levels. A larger proportion of the road building and harvest activities would occur adjacent to Class III, and IV streams where much of the available timber still remains.

Resident Trout - The habitat capability for resident trout populations would be influenced by streamside cover, woody debris and erosion as with anadromous fish, but to a lesser degree Forest-wide. The majority of trout production sites are located in reservoirs and in Wilderness lakes, and in the McKenzie River system. The lakes are less affected by timber harvest activities than are streams and rivers. In-stream production is a small portion of trout production on the Forest and much of the in-stream production is also supplemented with hatchery stock.

All alternatives would complete 1335 acres of reservoir improvement, presuming adequate funding and technological developments. Alternatives W (PA), D, and L would accomplish an additional 118 acres of streamside improvement for resident trout. As a result, there is only a 3% difference in trout populations based on habitat capability between Alternative L and Alternative K; Alternative L would produce 2,505,900 legal size trout and Alternative K would produce 2,426,800 fish in the first decade. All of the alternatives, except Alternative NC, manage for over 97% of the biological potential for resident trout. Population outputs for trout were not determined for the No Change Alternative.

Sensitive Species - Two fish species currently listed as Sensitive in the Region are bull trout *Salvelinus confluentus*, and the Willamette Oregon chub *Oregonicthys crameri* exist on the Forest.

Bull Trout populations are currently found in the McKenzie sub-basin, including the South Fork McKenzie. Historically the populations were also found in the Middle Fork Willamette and North Fork Middle Fork Willamette, and the North Santiam. Currently an multi-agency group including U.S. Forest Service, Oregon State University, Oregon Department of Wildlife, and National Park Service, are cooperating to evaluate the status of the populations.

Many of the factors which limit these populations are not yet understood, however it is known that water temperature is important for initiation of breeding, for embryonic development, rearing, and for adult habitat. They are seldom found in tributaries with summer temperatures exceeding 18 degrees C, and are often found near cold perennial springs. (USDA Forest Service, 1989)

Alternatives W (PA) and L provide the best protection of this species, because no harvest is programmed from riparian areas in these alternatives, and risk of increases in stream temperature is low. It is possible that future management of this species may require reestablishing it in its historical species. This would be made more difficult under alternatives with programmed harvest in riparian areas due to a greater probability of increases in water temperature.

The Willamette Oregon chub was historically widespread throughout the Willamette drainages, and is now restricted to scattered populations along 15 miles of the Middle Fork Willamette. This species inhabits areas with primarily slow velocities, such as those created in overflow channels of flooding rivers. The containment of the Willamette River for flood control purposes has reduced the historical habitat of this species. Population declines may also be due to competition from introduced species. (Pearsons 1989)

The Fish and Wildlife Service was petitioned in the spring of 1989 to list this species as Threatened. The agency will follow the established procedure in making the determination of status. Management of habitat for this species will be based on recommendations developed in cooperation with ODFW. These would be followed under all alternatives.

Cumulative Effects on Fish - Many of the Forest's fish are anadromous fish, and as a result, utilize both on Forest and off Forest habitat. The construction of reservoirs by the Army Corps of Engineers has interfered with access to and from the potential habitat on the Forest and has totally blocked access to 66% of it. Continued interference with emigration and immigration due to management of interspersed private land may prevent the Forest habitat rehabilitation efforts from becoming fully effective and populations from reaching levels where the available habitat would be fully utilized.

Both habitat capability and fishery populations are expected to increase in the future due to rehabilitation projects. In the short-term, bedrock-control type streams would be rehabilitated more rapidly due to advances in current technology. Glacial out-wash type streams would be harder to rehabilitate because hydraulic responses are less predictable and the base of current knowledge for anchoring large structures within streams is still on-going. Over time, habitat projects that improve fish passage around reservoirs will provide access to additional habitat.

Mitigation Measures for Fish

The management activities that take place in the Forest's watersheds are governed by standards and guidelines that specify ways to protect features of quality fishery habitat for water temperature and turbidity. On a site specific basis, additional mitigation measures can include a wide range of actions that avoid, minimize, rectify, reduce or compensate for undesirable environmental impacts on the fishery resource.

The degree to which they will be applied will be relative to the amount and location of the activities proposed by the alternatives and site specific impacts. For example, Knutson-Vandenberg Act funding opportunities for fish habitat improvement projects would be higher in alternatives with high levels of timber harvest to mitigate for adverse conditions caused by timber sales and road construction.

Habitat improvement projects can be specifically designed to establish desirable habitat conditions and also to correct past adverse impacts on fish resources. Proposed projects should be evaluated for need as well as cost-effectiveness. Special projects can include cleaning spawning and rearing beds, rehabilitating riparian areas, improving fish passages, and modifying stream structure with gabion construction or logs to create more diverse habitats and improved pool/riffle ratios.

In Alternative W (PA), protection of the vegetation in the areas within 100 feet of perennial streams, wetlands, flood plains, lakes and other large water bodies will reduce impacts on fish habitat. The existing vegetation will be utilized to shade the stream channel and to reduce erosion. Large woody debris will be maintained in perennial streams and lakes at a minimum of 90% of the existing level. In certain site specific upland areas adjacent to these riparian corridors, soil and vegetative disturbance will be minimized by requiring suspension of logs during logging. Disturbance during yarding operations can also be minimized by directional felling of trees.

Protection of water supplies for hatcheries can be accomplished by many of the same site specific measures previously discussed, and those discussed in the Water section.

Road construction, reconstruction, or maintenance projects adjacent to or within streams can increase deposition of sediment and cause temporary impacts on water quality. Potential adverse effects to fish can be minimized by scheduling work outside of spawning or migration periods, and during slack fishing periods. Scheduling work during normal dry seasons will allow newly disturbed areas sufficient time to be rehabilitated prior to the rainy season. Deposition of sediments can be reduced by designing roads and access routes to minimize road cut and fill erosion, and by reseeding and replanting exposed areas (Reeves 1982).

Debris jams that impede fish migration, or remove suitable spawning areas from production, may be removed as long as removal does not adversely affect stream gradient and configuration. The debris may be removed in phases, and conditions can be monitored periodically. When a culvert hinders or blocks upstream access, replacement may be the best approach, and new culverts can be positioned to protect fish habitat. Culverts can be placed to allow sediments to accumulate, creating dart and rest areas for small fish. Road reinforcement structures such as pilings or walls can also be placed to form slow moving pools within a stream (Reeves and Roelofs 1982).

Fishing is a form of dispersed recreation that directly affects fish populations. To a large degree, ODFW regulates the level of fishing by setting catch limits and seasons. Developed sites tend to concentrate fishing pressure which often decreases fishing success, although increased fishing pressure may be beneficial to some brook trout populations where fish size is stunted due to overpopulation. Trampling of riparian vegetation near streams and lakes can also impact fish habitat. Damaged sites can be rehabilitated and restrictions can be placed on dispersed campsite locations and conditions. Access sites for fish liberation trucks can be spaced to allow a better distribution of fish and provide dispersion of anglers.

Relationships with the Other Agency Plans or Policies for Fish

There are a number of plans and policies formulated by other parties with regard to the management of the aquatic habitat. Most of these plans and policies have elements that deal specifically with fish habitats. In general, they address two basic elements of fish habitat: (1) the maintenance of existing habitat; (2) the restoration, rehabilitation, and/or enhancement of fish habitat.

Four pertinent plans or programs:

- *The Columbia River Basin Fish and Wildlife Program, 1984,* (Northwest Power Planning Council). This plan was prompted by passage of the Pacific Northwest Electric Power Planning and Conservation Act of 1980 (P.L. 95-501). This plan emphasizes the restoration of Columbia River anadromous fish runs diminished by basin-wide hydroelectric development and operation. Restoration provisions include protecting fish survival, encouraging their reproduction, and rehabilitating and enhancing their habitats in the Columbia River and its tributaries.

- Sub-basin plans for the Santiam, Calapooia, McKenzie, Middle Fork Willamette and Willamette mainstem are currently being reviewed for consistency with this plan. Upon adoption by Northwest Power Planning Council and Bonneville Power Administration, they will have a profound effect upon all agencies responsible fish and fish habitat. These sub-basin plans will establish specific goals and prioritize habitat investments.

- *Comprehensive Plan for Production and Management of Oregon's Anadromous Salmon and Trout, 1982* (Oregon Department of Fish and Wildlife). This statewide plan deals with all major anadromous species. Habitat management considerations focus on the maintenance and improvement of anadromous fish habitat.

- *Oregon Wild Fish Policy* (Oregon Department of Fish and Wildlife). This policy formally recognizes the need for habitat-based, wild, and natural fish production.

- *Willamette Basin Fish Management Plan,* 1988 (Oregon Department of Fish and Wildlife). A key feature of this plan is a section that emphasizes the importance of maintaining fish habitat to ensure fish populations remain at high levels.

Inadequate information

Inventory of quantity and quality of aquatic habitat suitable for spawning, rearing and feeding of salmonid Management Indicator Species.

Smolt density coefficients derived from site specific studies.

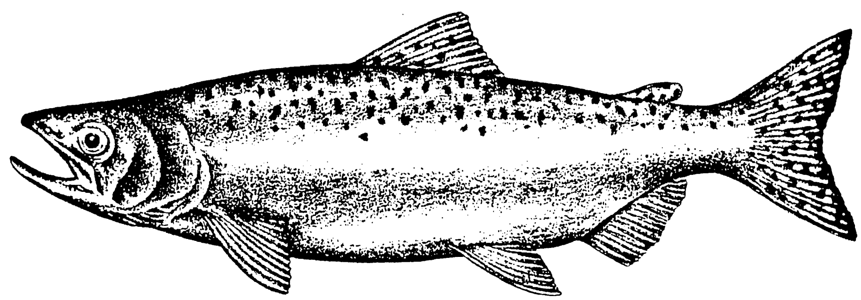
Determine thresholds of sediment and turbidity above which negative effects on fish and fish habitat occur.

Determine the role of food sources from Class III and IV streams on Class I and II habitat.

Determine the influence of gravel stability on the survival of salmonid eggs and fry.

Determine the amount of instream large woody material necessary to meet objectives for fish production.

Assess the results of stream rehabilitation projects on fish population dynamics.
Bull Trout habitat, populations, distribution, and other characteristics as described in the "Research Needs" section of "Biology of the Bull Trout" Willamette National Forest, 1989.



Environmental Consequences Of The Alternatives On Wildlife

A diverse array of wildlife species reside on the Forest. More than 170 avian species, 64 mammalian species, and 30 amphibian and reptilian species use habitats found on the Forest for all or a significant portion of their life history needs. Numerous physical, biological, and environmental factors interact at stand and landscape levels causing the number of individuals within populations to fluctuate over time. These fluctuations can be natural or caused management activities. Management activities have direct, indirect, and cumulative effects on wildlife populations and their habitats.

Particular species have been chosen as management indicator species (MIS). Management indicator species represent a broad group of species dependent on, or associated with, similar habitat conditions. The primary assumption used in the indicator species concept is that by managing for viable populations of indicator species, the viability of all other species that require similar habitats will be maintained. This group of wildlife species serves as one measure of vertebrate diversity across the forest.

A discussion on the selection of MIS and the habitats they represent is presented in Chapter III, Wildlife.

Direct and Indirect Effects of the Alternatives on Wildlife

Diversity of Vertebrate Species - All of the alternatives, except No Change, have been designed to provide for a diverse mix of wildlife habitats capable of sustaining viable populations of native and desirable non-native vertebrate species. Some wildlife populations are directly impacted during management activities such as timber harvest, road construction, mineral extraction, and fire. Small mammals, reptiles, amphibians, and nesting bird species are most likely to be directly impacted because of their limited mobility. Significant population loss throughout the Forest would rarely occur as a direct effect of management activities, but localized segments of the population could be lost or isolated. Management activities involving the release of species could directly increase populations in localized areas. Examples would include transplanting elk or release of peregrine falcons.

Indirect impacts to wildlife species are more subtle and vary greatly depending on the amount of habitat loss, change, or disturbance. Changes in habitat composition, structure, and distribution results in subsequent shifts of species composition and population densities within the Forest as well as off the Forest. Some species are migratory, using habitat on the Forest during breeding seasons and then moving to other locations during winter months. Others, such as elk, migrate from higher portions of the Forest to discrete wintering grounds on other portions of the Forest. In addition, a species' habitat requirements may change through the year, with nesting or calving requiring one type of habitat, while feeding or protection from the weather may require another.

The No Change Alternative (NC) does not incorporate the provisions of the National Forest Management Act (NFMA) requiring diversity of animal communities be maintained and maintenance of habitats for well distributed viable populations of vertebrate species. Wildlife populations are at greatest risk in Alternative NC. Habitat provisions in the current forest management plan (NC) would meet Recovery Plan requirements for federally listed threatened and endangered species.

All alternatives except NC, rely on the MIS strategy to meet the diversity intent of NFMA. The selection of MIS species is described fully in Chapter III. Each alternative results in different habitat characteristics and distribution.

Management Requirements for habitat quality, quantity, and distribution for MIS are met in Alternatives A, J, K, and W (PA). Alternatives D and L provide habitat levels which exceed Management Requirements

(MRs). Alternatives J, W (PA), D, and L, respectively, provide increasing protection for special and unique habitats reducing the risk of losing species diversity.

Northern Bald Eagle: Threatened Species - The northern bald eagle is federally listed as a threatened species. As identified in the Pacific States Bald Eagle Recovery Plan (1986), the population recovery objective for the Forest is 20 pairs of bald eagles. Protection and enhancement of bald eagle habitat must include consideration of nest sites (current, future,and replacement), roost sites, and foraging areas.

Chapter III, Wildlife, describes the habitat requirements and Recovery Plan objectives for the bald eagle. Figure IV-16 displays bald eagle habitat by alternative.

Management activities proposed in all alternatives that would directly impact bald eagles are timber harvest, road construction and maintenance, and recreation developments. Allowing these activities to occur in and around occupied territories could directly impact bald eagles by causing them to avoid or abandon nest sites, roost sites, or foraging areas (Anthony, 1990 personal communication).

Indirect effects could also occur, impacting the potential recovery of the bald eagle. Indirect effects to bald eagles include management practices that reduce habitat suitability by harvesting potential nesting or roosting habitat, result in significant reductions in potential food resources, or allow disturbance in key use areas, causing abandonment or precluding establishment of a territory.

Alternative NC (No Change) would comply with the Threatened and Endangered Species Act of 1973, as amended, and the Pacific States Bald Eagle Recovery Plan. Bald eagle habitat would be managed to meet established Management Requirements (MRs). Alternatives A and K manage bald eagle habitat at the MR level. Alternatives J, W (PA), D, and L increase the potential for population recovery. Alternative W (PA) would increase protection around potential and existing nest sites to at least 125 acres and would require biological evaluations of all activities occurring within 1.1 miles of eleven major water bodies with known or high potential for bald eagle territories. Alternative J would manage for the same number of sites as Alternative W (PA), but the potential nest sites would average 30 acres in size. This is smaller than recommended for protection of nest areas (Anthony 1989). Alternatives W (PA), D and J provide protection of additional potential nest sites above that required in the Recovery Plan and would include habitat provisions as recommmended by Anthony (1989) and McAllister et.al.(1989). Alternative L impacts the fewest acres of old growth habitat, thus would provide the highest amount of nesting and roosting habitat throughout the Forest.

Alternatives W (PA), D, and L provide the most potential for long-term recovery of the bald eagle. Emphasis on timber harvest, road construction, and developed recreation sites combined with minimal protection of potential territories in Alternatives NC, A, K, and J would result in lower probability that long-term recovery objectives would be achieved or maintained.

Table IV-16. Prescribed Management Level for Bald Eagle Habitat

	Alternatives						
	NC (No Change)	K	A	J	W (PA)	D	L
Habitat Acres Associated with Existing Pairs [1]	150	150	150	150	625	625	625
Acres Potential Habitat [2]	480	480	480	570	2375	2825	2825
TOTAL							

[1]These acres reflect roosting and foraging habitat known to be utilized by the existing pairs of bald eagles as well as specific nest sites.
[2]Habitat identified is around key feeding areas and potential nest sites, not formally surveyed.

Peregrine Falcon: Endangered Species - The peregrine falcon is federally listed as an endangered species. In the Pacific states, peregrine falcons nest almost exclusively on cliffs, usually near water and an abundant prey source. Although there are no known pairs of peregrine falcons on the Forest, they do nest in similar habitats on adjacent Forests. Twelve sites have been identified on the Forest as high potential nest sites by the Oregon Department of Fish and Wildlife (ODFW). They are located on rock cliffs having horizontal ledges for nesting.

The peregrine falcon is particularly sensitive to disturbance near the nest cliff during the breeding season. If human activities are occurring throughout the nesting area, the entire territory may be abandoned, and the pair may not nest (Hickey 1942, Fyfe and Olendorff 1976). Use of the organochlorine pesticides, particularly DDT, was the greatest factor contributing to the decline of the peregrine falcon (USFWS 1982).

Timber management activities can indirectly affect peregrine falcon recovery potential by impacting special and unique habitat such as meadows, hardwood stands, marshes, and bogs which often support high populations of birds used as a food resource. Timber harvest may provide additional prey populations by creating openings preferred by many of the peregrine's prey species. Silvicultural practices such as vegetation control using herbicides that reduce vegetation diversity and structure could reduce the potential population of birds within the openings. Where this occurs within a potential territory of a peregrine falcon, adverse indirect effects to recovery objectives could occur.

All of the alternatives meet the minimum habitat protection requirements of the Pacific Coast Recovery Plan for the American Peregrine Falcon. The most limiting factor for meeting recovery objectives on the Forest is the low population densities with the Pacific States recovery zone. Alternatives NC, A, and K would result in aggressive timber harvest and roading programs, with the least emphasis on maintaining habitat diversity. These alternatives would have the greatest potential to affect peregrine falcon recovery. Alternatives D, W (PA), L respectively, would place increased emphasis on maintaining vegetation and habitat diversity and would provide the highest potential to meet or exceed Recovery objectives.

Northern Spotted Owl: Ecological Indicator Species - As an ecological indicator of mature and old growth forest habitats, the northern spotted owl represents those vertebrate communities associated with late stages of forest succession. See Wildlife in Chapter III for a more detailed description of northern spotted owl habitat.

Management activities are most likely to directly impact spotted owls during the breeding and nesting seasons. Road building and timber harvest occurring between February 1 and September 30 have the highest potential for direct impacts. Noise caused by road construction machinery, skyline logging systems, blasting, and felling trees would cause significant disturbance near nest trees and natal areas (Forsman 1989, personal communication). Felling of trees may cause mortality to nestlings or fledglings not yet old enough to disperse away from the disturbance. Miller (1989) found most juvenile spotted owls stayed within natal areas an average of 104 days after fledging. Dispersal of juvenile spotted owls began in September.

Recreation activities are less likely to cause direct impacts unless high use trails and campsites are located within natal areas. Adult spotted owls have the ability to disperse from disturbance activities and have a low probability of being directly impacted. Spotted owls are relatively easy to locate and approach, making them susceptible to harassment or destruction by people.

Indirect effects of the proposed alternatives to northern spotted owls are extensive. Changes in habitat quality, quantity, and distribution would result from land allocations and management activities. Impacts to prey bases, competition and predation from species adapted to early successional or edge habitats, and fragmentation of suitable habitat will result in long-term reduction of spotted owl populations (Thomas et al. 1990). The primary land management activities causing indirect effects occur as a consequence of harvesting mature and older trees, road construction, fire, mineral development, silvicultural practices, and vegetation management. Conversion of old-growth and mature forests to managed plantations eliminates many vegetation attributes needed to support those species associated with existing mature and old growth forests. Silvicultural strategies involving maintenance of vigorous stands and harvest rotations less than 200 years have a low potential as replacement habitat in the future because of the lack of canopy layers, snags, and down logs which typically describe preferred habitat of spotted owls (USDA Forest Service, FSEIS 1989). Figure IV-17 displays the amount of mature and old-growth forests that occurred on the Forest when timber harvest began in about 1940, the current condition, and the amount remaining at the end of each future decade, by alternative. Effects of fragmentation on suitable habitat are not represented.

Past and current intensive timber management activties including timber harvest and road construction have resulted in a highly fragmented landscape. The impact this has had on the spotted owl population is unknown. Future consequences of these acivities, as represented by Alternative NC, would include a rapid decline in habitat followed by a probable decline in the spotted owl population. Concern for the future viability of the spotted owl has led to a proposal to protect the northern spotted owl under the Endangered Species Act by listing it as Threatened and Endangered throughout its range.

In compliance with the Record of Decision (1989) and Amendment to the Region 6 Guide for the northern spotted owl, suitable habitat will be provided to maintain habitat capable of supporting a viable population in Alternatives A, K, J, W (PA), D and L. All alternatives, except NC, meet or exceed MRs for the establishment of a Forest-wide spotted owl habitat network. The habitat capability for spotted owls would increase above the MR in Alternatives D and L. Protection of spotted owl habitat in Alternatives D and L would increase the number and distribution of suitable habitat islands and would reduce the risk of isolating small populations of spotted owls. Figures ***** and ***** display the estimated impact to spotted owls and their habitat by alternative.

All alternatives would provide habitat capability for 35 pairs of spotted owls in "reserved" lands such as Wilderness. Fifteen pairs have been verified as occurring in wilderness areas since 1985. An additional 60 pairs would be present within the Forest-wide SOHA network. Alternative D would provide habitat capability for 137 pairs and Alternative L would provide habitat capability for the full inventory of 219 verified pairs of spotted owls. The population of spotted owls on the Forest could continue to decline in all alternatives. Only Alternative L provides timber harvest rotations and harvest levels which may allow the population level to stay near current densities and possibly increase over the long-term.

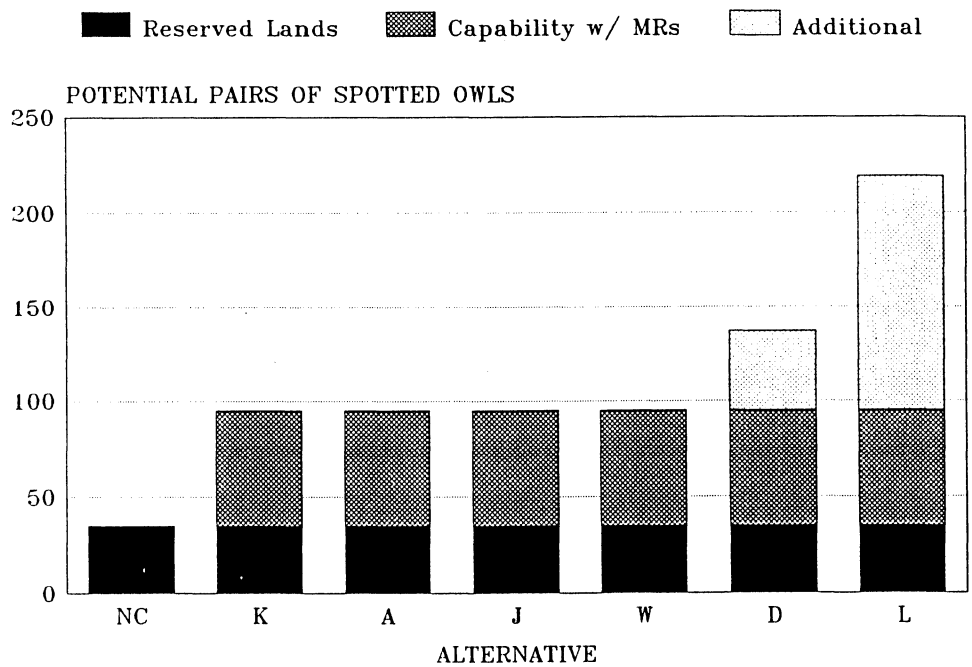
Alternatives have direct and indirect effects on spotted owls, and the species represented by them, in proportion to their emphasis on harvest of existing mature and old growth forests, road building, and other resource extraction activities. Additional impacts are caused in alternatives that minimize allocation for watershed protection, scenic values, recreation opportunities in primitive or semi-primitive settings, and retention of dead and down woody material.

All alternatives have similar potential for adverse consequences from wildfire at the current condition. Over time, the potential for severe adverse consequences would increase as fire resistant mature and old growth stands are converted to young, even aged plantations susceptible to severe fire damage. As fragmentation of fire resistant stands occurs and as stands become smaller islands within the managed landscape, the potential for direct adverse effects to spotted owls and their habitat would increase.

Prescribed fire and wildfire may adversely impact spotted owls where smoke inundation occurs in natal areas or when slash burns escape harvest unit boundaries into suitable spotted owl habitat. Alternatives that harvest the most acres of land would have a proportional increased risk of adverse consequences. Analysis of the number of wildfires reported on the Forest indicates most fires occur as a result of escaped slash burns, or other human activities assiciated with increased access resulting from timber harvest. Refer to Air Quality and Vegetation sections in Chapter IV for a more detailed discussion on causes and effects of fire.

The potential for adverse direct or indirect effects on spotted owls for all proposed Forest activities, ranked from most to least impact, would be Alternative NC, K, A, J, W (PA), D, and L, respectively.

Figure IV-8. Prescribed Management Level of Spotted Owl Pairs



	Alternatives						
	NC (No Change)	**K**	**A**	**J**	**W** (PA)	**D**	**L**
SOHA Level[1]	NA[2]	60	60	60	60	60	60
Additional Provided [3]	0	0	0	0	0	42	124
Capability in Reserved Lands[4]	35	35	35	35	35	35	35
TOTAL CAPABILITY IN PAIRS	35	95	95	95	95	137	219

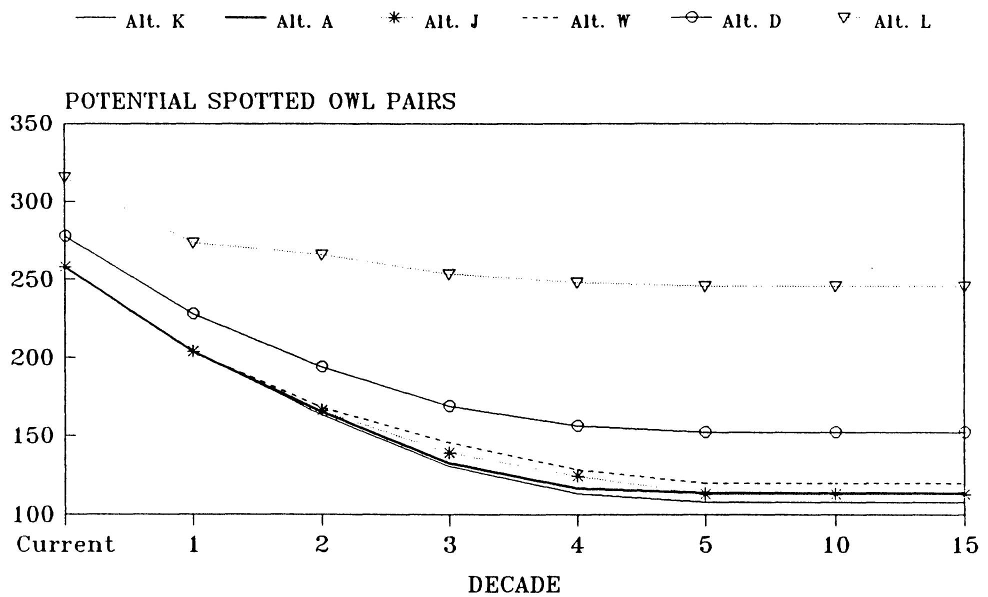
[1]Verified pairs of spotted owls located within the MR SOHA network.
[2]NA = Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model. These differences are described in Chapter II of the FEIS as part of the discussion of the No Change Alternative.
[3]Verified pairs of spotted owls protected above MR levels; based on habitat capability in Alternative L and additional SOHA designation in Alternative D. Habitat may not meet management requirements for distribution.
[4] Potential pairs of spotted owls based on capability in wilderness.

Table IV-17. Mature and Old-growth Habitat

Decade	Alternatives [1]						
	NC (No Change)	K	A	J	W (PA)	D	L
1st	NA[2]	484.7	500.8	490.7	495.4	454.5	545.7
2nd	NA[2]	412.0	439.5	423.2	441.4	395.6	520.4
5th	NA[2]	267.4	307.3	299.3	327.5	285.1	485.4

[1]Acres of old-growth forest remaining at the end of each decade. Acres include Wilderness.
[2]NA Data not Available, could not be reasonably estimated or compared to the other alternatives since Alternative NC is based on a significantly different set of assumptions than the other alternatives and could not be modeled on the Willamette National Forest FORPLAN Model.

Figure IV-9. Spotted Owl Habitat Capability



Decade	Alternatives						
	NC (No Change)	K	A	J	W (PA)	D	L
Beginning Inventory	257.9	257.9	257.9	257.9	257.9	257.9	257.9
1st	NA[2]	203.9	203.9	203.9	203.9	227.9	273.7
2nd	NA	163.2	165.3	166.2	168.4	194.2	265.8
3rd	NA	130.4	132.6	139.1	145.8	169.1	253.5
4th	NA	113.1	116.5	124.3	128.5	156.5	248.1
5th	NA	107.8	113.9	112.7	120.0	152.4	245.6
10th	NA	107.8	113.9	112.7	120.0	152.4	245.6
15th	NA	107.8	113.9	112.7	120.0	152.4	245.6

[1]Values reflect estimates for the number of pairs that the habitat is capable of supporting.
[2]NA = Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model. These differences are described in Chapter II of the FEIS as part of the discussion of the No Change Alternative.
[3]Current habitat capability is 187 pairs based on 152 pairs verified and 35 potentially suitable sites not formally surveyed.
[4]After the 5th decade, it is assumed that old-growth stands of timber will remain only in the Allocations withdrawn from timber harvest.

Pileated Woodpecker: Ecological Indicator Species - The pileated woodpecker represents those wildlife species associated with mature and old-growth forests of the true fir, true fir/Douglas fir, Douglas fir/western hemlock, and Douglas fir vegetation series. The habitat requirements are broader than those identified for the spotted owl. The size of trees available for cavity excavation determines habitat capability and is used to determine the forest vegetation series that comprise suitable pileated woodpecker habitat on the Forest. The size and number of snags used for nesting and roosting have been documented by Mannan (1982) and Mellen (1987) for the Douglas fir forests west of the Cascade Range.

Distribution of contiguous forest stands containing high numbers of large, standing, dead trees is a limiting factor for future population potential. Chapter III, Wildlife, contains a complete discussion of the MR for pileated woodpeckers.

Fire and felling of trees during breeding seasons are the primary activities likely to result in direct impacts to pileated woodpeckers. Most management activities directly impact the availability and distribution of habitat, and indirectly influence changes in populations densities.

Management activities that harvest mature and old-growth trees, increase forest fragmentation, and result in landscapes dominated by managed stands less than 100 years old would have the greatest impacts on nesting and roosting habitat of pileated woodpeckers. Forests less than 100 years old would not have developed the size, number, and distribution of snags required for viable populations of pileated woodpeckers. Some sites have a lower potential for tree growth and considerable more time could be required for development of suitable nesting and roosting habitat.

Snags, downed trees, and large green trees also serve as important sources of food for pileated woodpeckers. As unmanaged stands with these characteristics are harvested and managed on rotations of less than 100 years, pileated woodpecker habitat on the Forest would diminish. Managed stands with trees greater than 14 inches dbh and canopies 40 or more feet tall, begin to provide habitat for dispersal and foraging (Mellen 1987). Suppression of trees during forest devlopment results in some tree mortality or insect outbreaks. These occurrences provide recruitment of dead and dying trees throughout the successional development of forest stands. Trees within managed stands on this Forest could begin to provide snags of adequate size for nesting and roosting at about 120 years of age. Forest-wide, harvest rotations of at least 150 years would be required to allow recruitment of adequate numbers and sizes of snags. Use of shelterwoods while foraging has also been documented, but pileated woodpeckers show an avoidance for early seral forest stands (Bull 1989, personal communication).

Because pileated woodpeckers forage extensively on insects such as carpenter ants and insect larvae, pest management activities that reduce these insects populations or use "sanitation" techniques involving the removal of dead or dying trees adversely affects prey bases critical to insectivorous species.

Wildfire has historically created high numbers of dead and defective trees in forest landscapes. Trees killed or injured by wildfire have lower resistance to insect or fungal invasion and provide long-term recruitment of snags, down woody material, and defective tree habitat. Prescribed fire could provide a similar function in managed stands, however, current procedures and activities associated with the control, suppression, and mop-up of prescribed fire and wildfire used in slash burning or control of wildfire could result in a net decrease in snag recruitment and retention.

Salvage of hazard trees, snags, and down trees within road rights-of-way causes additional loss of habitat. The impacts of salvage associated with road maintenance and use increase as the number of miles of road maintained increases.

For all alternatives, with the exception of Alternative NC, pileated woodpecker habitat would be provided to maintain viable populations. Figure IV-10 displays the impacts to suitable pileated woodpecker habitat over time, by alternative. Alternative L would provide the highest number of habitat acres, followed by Alternatives D, W (PA), J, A, L, and NC, respectively. Alternatives L and W would provide management strategies for replacing pileated habitat acres, using extended rotations with retention of large green trees to simulate conditions found in native, unmanaged stands. Alternative D would provide the second highest habitat capability, but would not provide the dispersal corridors prescribed in Alternatives W (PA) and L. Pileated woodpeckers and their habitat would be at highest risk in Alternatives NC, A, and K, respectively.

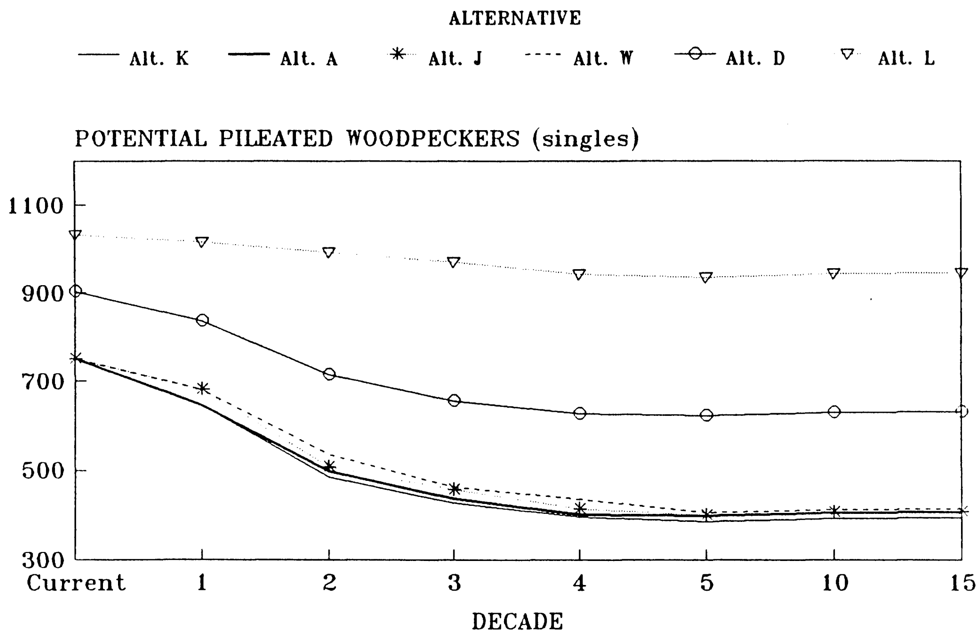
Table IV-18 displays the potential population of pileated woodpeckers on the Forest by alternative. The potential population number was derived from a combination of habitat capability provided in reserved lands, spotted owl habitat areas, pileated woodpecker habitat areas, and general forest. Each spotted owl habitat area is assumed to provide enough habitat for a pair of pileated woodpeckers. Reserved lands and general forest were evaluated to determine the amount, distribution and quality of suitable pileated woodpecker habitat. The analysis process is described in Appendix B.

Table IV-18. Prescribed Management Level of Pileated Woodpecker Habitat [1]

	Alternatives						
	NC (No Change)	K	A	J	W (PA)	D	L[2]
Pileated Woodpecker Habitat Areas	NA[3]	38	38	38	38	38	--
SOHAs[4]	NA[3]	118	118	118	118	274	355
Reserved Lands[5]	83	83	83	83	83	83	83
Total Habitat Capability	83	239	239	239	239	395	438

[1]Includes only protected mature and old-growth habitat suitable for pileated woodpeckers. Habitat capability is expressed as potential numbers of individual pileated woodpeckers.
[2] No specific allocation of pileated woodpecker habitat is needed to meet MR levels for habitat quality or distribution; capability is maintained by the existing condition.
[3]NA = Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model. These differences are described in Chapter II of the FEIS as part of the discussion of the No Change Alternative.
[4]These SOHAs reflect the management requirement (MR) level for spotted owls on the Willamette National Forest.
[5]Pileated woodpecker habitat areas located in Wilderness and undeveloped roadless areas. Habitats may not meet minimum management requirements for distribution.

Figure IV-10. Pileated Woodpecker Habitat Capability [1]



	Alternatives						
y Decade	NC (No Change)	K	A	J	W (PA)	D	L
1st	NA[2]	645.2	645.2	682.1	680.7	836.9	1014.2
2nd	NA	485.0	498.8	508.1	535.6	714.9	991.7
3rd	NA	426.6	438.0	458.1	463.8	655.1	969.4
4th	NA	395.1	401.7	414.9	435.6	627.5	941.9
5th	NA	384.9	398.5	399.5	405.2	622.1	935.3
10th	NA	392.4	406.0	407.0	412.7	629.3	942.8
15th	NA	393.9	407.5	408.5	414.2	631.0	944.3

[1]Values reflect estimates for the number of individuals that the habitat is capable of supporting.
[2]NA - Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model. These differences are described in Chapter II of the FEIS as part of the discussion of the No Change Alternative.

Potential population trends, projected over 15 decades, indicate that pileated woodpecker populations would remain at or above the MR level in all alternatives, but NC. These trends assume no catastrophic events result in the loss of habitat network sites. Loss of network habitat areas would increase isolation of populations. The effect this would have on viability of pileated woodpeckers is unknown. Studies of other nonmigratory, large, long lived birds indicate there may be cause for long-term viability concern with the strategy used in development of the Management Requirements for pileated woodpeckers (Thomas et.al. 1990).

Marten: Ecological Indicator Species - Marten is the management indicator species (MIS) for wildlife that utilize mature and old-growth forests of true fir, mountain hemlock, True fir/Douglas fir, Douglas-fir/hemlock, and Douglas fir vegetation series. Marten are secretive, nocturnal mammals and are not readily observed. Marten have historically been trapped for their fur. ODFW regulates the harvest of marten populations.

Marten are highly mobile, and direct effects on populations would most likely occur as a result of trapping, or loss of young during timber harvest operations.
Timber harvest, fire, and road construction have the greatest direct effect on marten habitat. These land management activities will impact habitat distribution and suitability resulting in indirect effects to population densities.

Martens utilize mature and old-growth forest types as primary habitat, but they disperse through, and hunt in, early seral stands having greater than 50% crown closure, high numbers of downed trees, and snags. Chapter III, Wildlife, contains a discussion on marten habitat and the MR for maintaining viable populations.

In Alternative NC, marten habitat may not be provided at levels needed to maintain viable populations. Habitat quality and distribution outside reserved lands (Wilderness, Research Natural Areas, etc.) would become a limiting factor. Populations would become isolated and overall population viability would decline as timber harvest and road construction fragment the landscape, reducing habitat capability.

All alternatives, except NC and L, use a combination of spotted owl, pileated woodpecker, and marten habitat areas to provide a network of well distributed mature and old-growth conifer habitat throughout the Forest. Habitat islands provided in the MR for pileated woodpecker and marten habitat areas may not be large enough to provide for breeding pairs of marten (Irwin 1987). The function of the habitat areas could be limited to provided "stepping stone" habitat for dispersing juveniles or adults seeking unoccupied territories located within larger habitat islands found in SOHAs or reserved lands. Where suitable habitat exists on lands available for timber production and is contiguous with designated habitat, habitat quality and quantity for breeding pairs would be present until those areas are fragmented or harvested.

Figure ***** displays the effect of timber harvest on the amount of suitable marten habitat available on the Forest, by alternative. Alternative L has the least effect on marten habitat because it harvests the fewest acres per decade, and provides extended rotations for recruitment of mature forest habitat. Relative impacts to marten habitat, thus population potential, listed in order of decreasing effect are Alternative NC, K, A, J, W (PA), D, and L, respectively.

Alternative W (PA) provides a well distributed habitat network with some provision which exceed the MR. The preferred alternative (W) would provide direction for maintaining 340 acres of managed stands meeting forage and dispersal requirements contiguous with 160 acres of protected mature or old-growth habitat for each habitat area. Protection of riparian corridors for dispersal and foraging, protection of special and unique habitats, and Forest-wide S&Gs for maintaining moderate to high amounts of large down material in managed stands would be emphasized. These factors increase the potential for well distributed, viable marten populations in Alternative W (PA).

Alternative D increases the number of spotted owl habitat areas. These additional sites were placed to provide larger habitat islands and increase the Forest-wide distribution of mature and old growth habitat. Marten habitat capability would be increased as as a result. Dispersal corridors are limited, and this could reduce interaction within the marten population Forest-wide.

Table IV-19 displays the projected effects to marten populations of the alternatives considered. These population estimates are based on habitat capability which includes an assessment of forest fragmentation, habitat availability within reserved and nonreserved lands, and distribution of habitats.

Table IV-19. Prescribed Management Level of Marten Habitat [1]

	Alternatives						
	NC (No Change)	K	A	J	W (PA)	D	L[2]
Marten Habitat Areas	NA[3]	100	100	100	100	100	--
Martens in PWHAs	NA[3]	38	38	38	38	38	--
Marten in SOHAs[4]	NA[3]	118	118	118	118	274	438
Marten in Reserved Lands	459	459	459	459	459	459	459
Total Habitat Capability	459	715	715	715	715	871	897

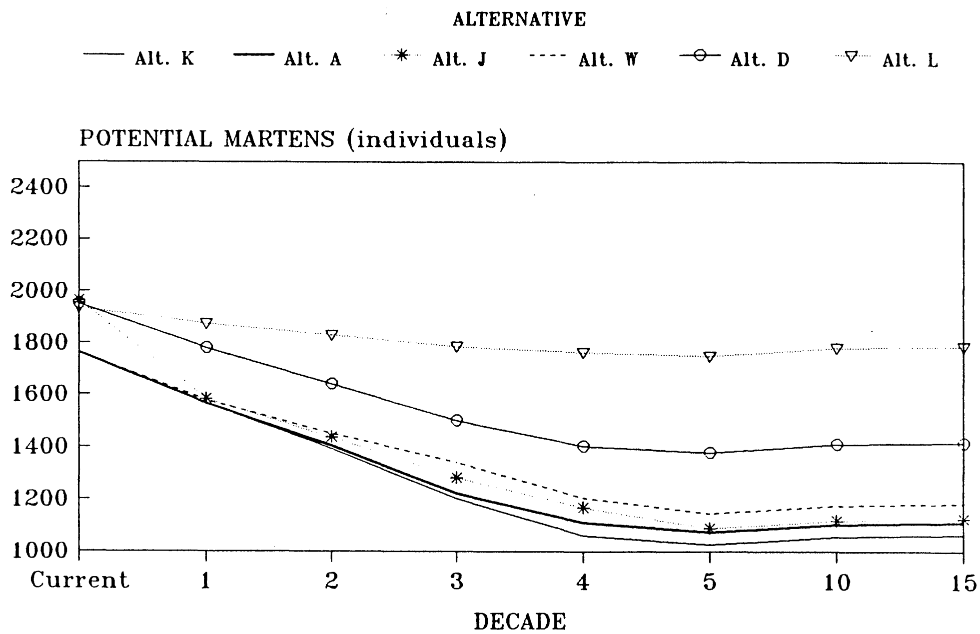
[1] Habitat capability for marten is expressed as potential population of individual martens. Includes only protected mature and old-growth habitat suitable for pine marten.
[2] No specific allocation is needed to meet MRs for habitat quality, quantity or distribution.
[3]NA = Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model. These differences are described in Chapter II of the FEIS as part of the discussion of the No Change Alternative.
[4]Each SOHA provides the equivalent of two pine marten areas.

Table IV-20. Mature and Old-growth Habitat[1]

	Alternatives						
Decade	NC (No Change)	K	A	J	W (PA)	D	L
1st	NA[2]	522.4	538.5	528.4	533.4	492.2	583.4
2nd	NA[2]	449.7	477.2	460.9	479.1	433.3	558.1
3rd	NA[2]	386.5	422.4	402.1	432.6	424.2	542.0
4th	NA[2]	327.5	374.3	351.3	391.6	380.3	530.8
5th	NA[2]	305.1	345.0	337.0	365.2	322.8	523.1

[1]Acres of old-growth timber remaining at the end of each decade. Acres include Wilderness.
[2]NA Data not Available, could not be reasonably estimated or compared to the other alternatives since Alternative NC is based on a significantly different set of assumptions than the other alternatives and could not be modeled on the Willamette National Forest FORPLAN Model.

Figure IV-11. Marten Habitat Capability [1]



	Alternatives						
Decade	**NC** (No Change)	**K**	**A**	**J**	**W** (PA)	**D**	**L**
1st	NA[2]	1567.6	1567.6	1583.8	1781.4	1580.1	1873.4
2nd	NA	1392.3	1405.4	1437.0	1640.7	1450.7	1829.2
3rd	NA	1201.9	1222.4	1282.5	1500.4	1340.5	1785.0
4th	NA	1061.9	1110.8	1168.4	1402.0	1205.6	1763.1
5th	NA	1027.3	1074.2	1089.3	1378.3	1145.1	1750.0
10th	NA	1058.2	1105.0	1120.2	1409.1	1176.0	1780.8
15th	NA	1064.3	1111.1	1126.2	1415.2	1182.0	1786.9

[1]Values reflect estimates for the number of individuals that the habitat is capable of supporting.
[2]NA - Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model. These differences are described in Chapter II of the FEIS as part of the discussion of the No Change Alternative.

Primary Cavity Excavators: Ecological Indicator Species - Dead and defective trees provide a unique habitat type for a diverse array of species. Associated with these decaying wood habitats are a wide variety of plants, animals and microorganisms essential to the nutrient cycling in the forest ecosystem. Maintenance of a dead and defective component in the forest provides a habitat requirement for many species that can not be filled by any other component of the forest. Loss of this component would result in a large loss in wildlife diversity.

Dead and defective trees provide essential habitat for species referred to as primary cavity excavators (PCE) and secondary cavity users. Primary cavity excavators are those wildlife species that excavate cavities for nesting and roosting. Secondary cavity users are those wildlife species that use cavities created by PCE species for their life history needs. Many insectivorous species use dead and defective trees as foraging substrates, regardless of whether they require cavities for nesting or roosting. Chapter III, Wildlife, provides a discussion on wildlife species dependent on dead and defective trees. Potential consequences to primary cavity excavator populations are assumed to indicate potential impacts to all species dependent on dead and defective trees.

Direct effects to species requiring dead and defective trees occur primarily as result of tree harvest during reproductive seasons. Cutting of hollow trees or trees containing cavities would cause direct mortality to nesting or denning species.

Activities such as timber harvest, firewood cutting, prescribed burning, and pest management have the greatest potential for adverse impacts to dead and defective tree habitat. Direct loss of habitat caused by management activities would indirectly influence population levels.

Pest management activities that focus on control of insect populations could deplete the forage resource, or cause poisoning if toxicants are used. Recruitment of dead and defective trees is often a direct result of insect damage. Pest control activities will result in reduced availability of replacement snags. The effects of pest management activities on insectivorous species cannot be inferred from assessments of habitat availability. Individual projects would need to be evaluated for environmental consequence of the specific pest management activity.

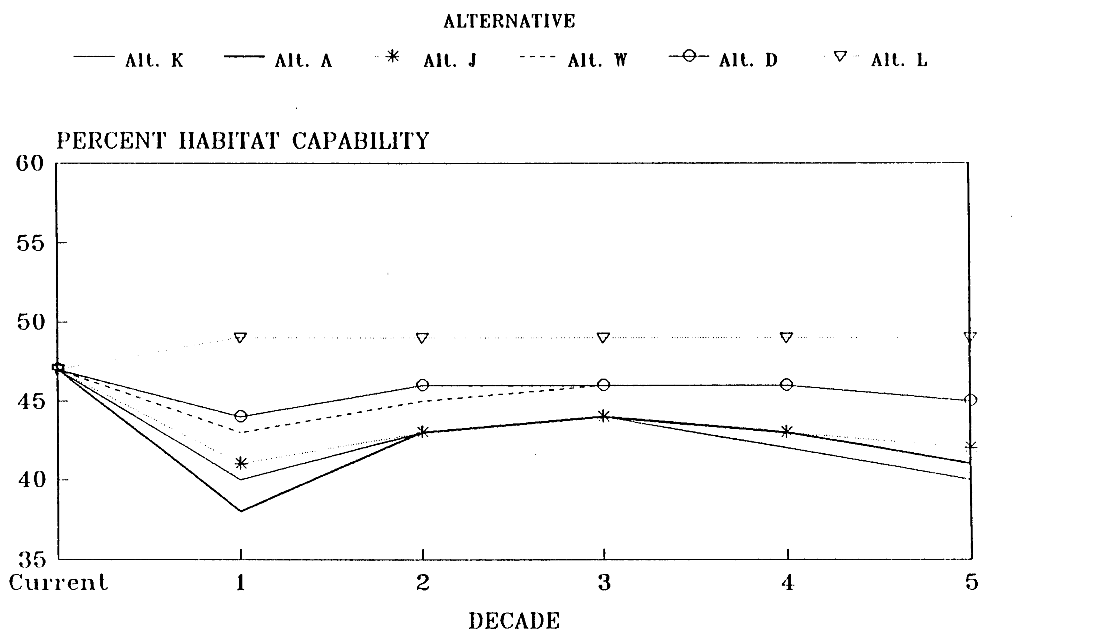
Although fire can consume snags and down logs which serve as forage and nesting habitat, it can also increase snag numbers and damage live trees, lowering their resistance to insect or fungal invasion. Of primary concern are the activities associated with the control, suppression, and mop-up of prescribed fire and wildfire. Historically, fire control resulted in the loss of high numbers of snags. This continues to be a concern in managed stands where fire is prescribed as a post harvest activity to meet specific resource objectives. Fire as a post harvest treatment has been used on most harvest acres and is proposed to be used on most harvested acres through the first decade.

The greatest impact to dead and defective tree habitat results from timber harvest. Salvage of dead and dying trees has occurred throughout most roaded subwatersheds. Salvagable dead trees are used as a component of the allowable sale quantity in all alternatives. Salvage within road rights-of-way results in an area approximately 100 feet on either side of roads being devoid of snags. Salvage activities would directly reduce the potential population of primary cavity excavators on lands available for timber production by 20% forestwide (Smith 1990). Few snags were left on areas harvested and burned in the past. This reduced potential populations of primary cavity excavators by an additional 35%. Retention of trees within harvest units has improved in recent years and would be required in all alternatives, except NC.

Some forest vegetation series may not have the biological capability to support 100% of potential populations because of the small size of trees available for cavity excavation. On this Forest, mountain hemlock stands may not achieve the 18 inch diameter required to support all species of cavity excavators identified on the Forest. Current habitat capability for potential populations of primary cavity excavators is 45%.

Alternatives NC and A have the most adverse effect on dead and defective tree habitats. Management direction in Alternatives J, K, and W (PA) provides for well distributed habitat within all harvest units, and would result in a moderate decline in habitat conditions. Retention of dead and defective tree habitat would be increased in Alternatives D and L causing the least impact to primary cavity excavator habitat.

Figure IV-12. Habitat Capability for Primary Cavity Excavators [1]



Decade	Alternatives [1]						
	NC[2] (No Change)	K	A	J	W (PA)	D	L
1st	NA[2]	2,435	2,340	2,542	2,639	2,696	3,001
2nd	NA	2,635	2,609	2,659	2,741	2,796	3,029
3rd	NA	2,675	2,690	2,677	2,798	2,813	2,998
4th	NA	2,604	2,664	2,622	2,803	2,832	2,992
5th	NA	2,448	2,521	2,571	2,764	2,781	3,019
10th	NA	3,563	3,696	3,850	4,116	4,103	4,551
15th	NA	3,423	3,546	3,778	4,060	4,058	4,652

[1]Values reflect estimates for the number of snags available for use by primary cavity excavators (in thousands of snags).
[2]NA - Data Not Available; could not be reasonably estimated, or compared to other Alternatives, since Alternative NC (No Change) is based on a significantly different set of assumptions than the other Alternatives, and could not be modeled with the current Willamette National Forest FORPLAN model. These differences are described in Chapter II of the FEIS as part of the discussion of the No Change Alternative.

Roosevelt Elk and Black-tailed Deer: Featured Species - Special emphasis has been placed on Roosevelt elk and black-tailed deer because of their economic and recreational importance. Recreational activities related to hunting, viewing, and photographing deer and elk result in significant contributions to local economies. Chapter II describes the projected outputs for deer and elk by alternative. A discussion on the habitat requirements for healthy, productive populations is presented in Chapter III.

Deer and elk use a wide variety of forest and non-forest vegetation types throughout the Forest. Most individuals and herds are migratory using higher elevations during summer months and lower elevations during winter. Migratory routes are often traditional with the same routes used year after year. Special and unique habitats such as meadows, marshes, bogs, and talus slopes are critical during specific times of the year.

Roosevelt elk are more sensitive to habitat changes and disturbance than deer, and therefore have more restrictive habitat needs. Thus, habitat requirements for elk are assumed to meet the requirements for deer as well. Elk were used as an indicator of habitat capability for deer in assessing the potential effects of the alternatives.

Hunting and poaching are two activities occurring on the Forest which have great direct effect on deer and elk populations. Severe winter weather with accumulations of deep snow also directly impact population levels, potentially causing significant population reductions. Large catastrophic fires cause some deer and elk mortality, but rarely result in significant population losses.

Management activities indirectly affect populations levels by directly impacting habitat suitability. The design, size, and placement of harvest units within a given landscape can be either beneficial or detrimental. Harvest of mature and old growth forests reduces cover quality, making deer and elk more susceptible to environmental extremes in summer and winter (Brown 1985). Timber harvest provides openings and edge habitats preferred by deer and elk for foraging. Alternatives NC, K, and A have the most potential to adversely affect cover quality Forest-wide because of high timber harvest levels and reduced emphasis on protection of optimal cover. Increasing emphasis would be placed on providing optimal cover (mature and old growth forest stands) in Alternatives J, W (PA), and D by protecting optimal cover on winter ranges, and protection of mature and old growth stands for other resource values including visuals, dispersed recreation, special interest areas, old-growth groves, special wildlife habitats, and riparian areas. Alternative L provides the the most acres of optimal cover, however distribution of forage openings would limit overall capability to produce deer and elk.

Presence of roads can have adverse effects on deer and elk. Open roads reduce the use of openings by deer and elk, increase potential for harassment and poaching, and reduce escapement of mature bulls during hunting seasons. Alternatives that harvest the highest number of acres have the most potential for adverse effects due to development and use of open roads. Specific habitat enhancement measures such as access management, gates and barriers, and vegetation retention can be implemented to mitigate road system development. Additional mitigation measures are described in the section of Chapter IV titled Mitigation Measures for Wildlife. Alternative D provides the highest emphasis on reducing the effects of roads followed by Alternatives L, W (PA), J, K, A, and NC respectively.

Fire affects deer and elk habitat by creating openings and influencing the vegetative species available for forage. Sprouting and growing vegetation in burned areas often has increased forage quality. Prescribed fire and wildfire create a high quality seed bed for the establishment of preferred forage species. In some cases, noxious weed species invade burned areas and result in a net decrease in the availability of forage (Smith 1979). All alternatives provide the same level of wildfire suppression. Prescribed fire is used in all alternatives and would result in similar effects on forage quality in harvest units (Wisdom et al 1986).

Recreation use in some areas would reduce the habitat quality for deer and elk. Hunted populations of elk are sensitive to the presence of people. Campsites and trails near or through meadows and marshes could adversely affect deer and elk use of these critical fawning, calving, and foraging areas. All alternatives have potential to impact elk and deer use of areas, however, Alternatives NC, A, K, and J provide few primitive or semi-primitive recreation opportunities outside of wilderness. This would increase the potential for impacts from high recreation use where special protected habitats occur. Alternative L, D, and W (PA), respectively, provide high to moderate opportunities for spreading recreation use Forest-wide.

Winter recreation has the potential to significantly impact deer and elk on winter ranges. Energy balances are critical during the winter period. Harassment of deer and elk by skiers, snowmobilers, campers, and hikers can cause disturbed animals to burn energy reserves that they may not be able to replace, depending on environmental conditions and the quality of habitat on the winter range. The consequence of high energy loss could result in population reductions through death, reduce birth rates, and poor survival of young the following spring. Alternative D provides the most habitat emphasis on protecting deer and elk winter range areas, followed by Alternatives L, W (PA), J, A, K,and NC, respectively.

Silvicultural and vegetation management practices influence the quality of deer and elk habitat. Reforestation and stocking control allow rapid recruitment of hiding cover (20 years) and thermal cover (40 years) following timber harvest. The long-term development of optimal cover is a function of time and would require estimated rotation lengths of 170 years or more. Precommercial thinning and vegetation management, involving cutting of brush, usually result in large accumulations of debris, leaving the treated area unsuitable for several years after treatment. In some plant community types, vegetative management activities that open the canopy by cutting brush improve forage availability by inducing basal sprouting. This practice has been used successfully on the Forest.

Vegetation management activities using herbicides are of special concern. Plants most preferred by deer and elk are most susceptible to being eliminated from treated stands. Elimination of preferred forage resources would increase the potential for severe damage to crop trees. Some concern exists as to the toxic nature of various herbicides. Little evidence exists as to toxic levels for deer and elk, however some toxic compounds are known to be stored in the internal organs and fat tissues. The Region 6 FEIS for Managing Competing and Unwanted Vegetation (1988) includes a discussion on the potential health hazards of using pesticdes.

All alternatives use intensive management techniques on all lands available for timber production. Potential for adverse effects from silvicultural and vegetation management activities would increase as the number of acres intensively managed for timber production increases. Potential for adverse effects to deer and elk also exist if too few acres are harvested and managed. Alternatives NC, K, and A have a high potential for adverse effects. Alternatives J and W have a potential for adverse effects, but like Alternative D, provide significant opportunities to use silvicultural and vegetation management techniques to develop high quality deer and elk habitat. Alternative L could have adverse effects on deer and elk as harvest levels are reduced and forage producing openings become limited Forest-wide.

Cumulative Effects of the Alternatives on Wildlife and Wildlife Habitat

Diversity of Vertebrate Species - Protection of special and unique habitats reduces the risk of adverse cumulative effects to those wildlife populations whose life history needs are not fully covered by Management Requirements. Alternatives listed in order of increasing risk of adverse cumulative effects to diversity are L, D, W (PA), J, A, K, and NC.

Alternatives W (PA) and L provide full protection of riparian ecosystems emphasizing the value of wildlife habitat in riparian corridors for foraging, nesting, denning, dispersal, and long-term connectivity between habitat islands.

Alternatives NC, K, and A would cause significant declines in habitat diversity by the fifth decade. Managed stands dominated by a few conifer species would dominate the forest landscape, resulting in isolation of protected habitat types and populations within three decades. Alternatives NC, A, K, and J result in high risk to special and unique habitats when they occur within or adjacent to stands suited for timber production.

Northern Bald Eagle: Threatened Species - Alternatives NC, A, K, and J have the greatest potential for adverse cumulative impact on habitat quality within 1.1 miles of major water bodies identified as potential bald eagle nesting, roosting, and foraging habitat. Protection of 40 acres for potential nest sites, while harvesting all other potential habitat reduces the probability that new territories would be established in the Recovery Zones. These alternatives would have the lowest potential for meeting recovery objectives and maintaining bald eagle nesting and roosting habitat in the long-term.

Alternative L and W (PA) would provide for the replacement of old-growth habitat over time in some Management Areas, thus loss of existing or potential nest sites through catastrophic events such as wildfire or windthrow would not limit long-term recovery potential.

All alternatives encourage developed recreation sites along the lakes, reservoirs, and rivers, creating significant potential for disturbance to existing territories and could preclude establishment of new territories along some designated water bodies. Only occupied territories which receive additional consideration due to site specific Bald Eagle Management Plans have a high probability for long-term viability. Mitigation Measures (Chapter IV) include conducting biological evaluation on all activities which would effect bald eagles. These measures are intended to minimize the adverse consequences associated with developed recreation sites.

Alternatives W (PA), D, and L would reduce the overall emphasis on roading and timber harvest,and would increase the protection of potential bald eagle territories. These alternatives would provide the highest potential to meet or exceed Recovery Plan objectives over the planning period.

American Peregrine Falcon: Endangered Species - Cumulative effects to peregrine falcons result as a consequences of changes in habitat conditions for prey species or impacts to the structure or microhabitat of nest cliffs. Because peregrine falcons feed extensively on songbirds, management activities that reduce habitat diversity or involve the use of toxicants have some probability of adverse cumulative impacts to recovery of the species.

Alternatives that reduce habitat diversity by converting the landscape to intensively managed conifer plantations with little structural or plant diversity, would have long-term negative indirect cumulative impacts. Peregrine falcons that would nest on the available cliffs may not have access to abundant bird populations required to sustain a viable population. Alternatives W (PA), D, and L, respectively, would have the highest probability of providing the habitat diversity and protection needed for recovery of peregrine falcon populations.

Alternatives NC, A, K, and J will create an abundance of openings that would provide foraging habitat as harvest levels remain high. Low emphasis on providing vegetative diversity within intensively managed stands, limited protection of special and unique habitats, and a landscape subjected to numerous intensive silvicultural treatments reduces the probability of providing the diversity of habitats or abundant bird populations needed to meet and exceed long-term recovery objectives for peregrine falcons.

Northern Spotted Owl: Ecological Indicator Species - Suitable spotted owl habitat will be restricted to reserved lands, lands unsuited for timber production, and lands subject to constrained harvest rates, by the fifth decade in all alternatives except L. Reduced rates of harvest occur in visual corridors and dispersed recreation management areas, 5% to 10% per decade. Spotted owls inhabiting these islands of suitable habitat will be at increased risk of eventually becoming isolated pairs or individuals. Alternative W provides a strategy to reduce habitat fragmentation, but harvest rates would eventually result in the same cumulative effect. Alternatives A, K, J, and W (PA) vary only in the rate at which direct loss of habitat results in declining populations. Alternatives W (PA), D, and L, respectively, would maintain increased potential for maintaining habitat capability above MRs through the fifth decade.

Dispersal of spotted owls through fragmented landscapes and across large expanses of unsuited habitat will increase the risk of mortality, as individuals attempt to locate unoccupied habitat islands. Fewer suitable acres of habitat Forest-wide, and limited distribution of habitats needed for nesting, feeding, and roosting, could result in increased adult mortality rates and decreasing juvenile survival. Dispersal opportunity would be highest in Alternative L and Alternative W (PA). Alternative L maintains high levels of suitable habitat Forest-wide. The preferred alternative (W) places management emphasis on riparian resources, visual corridors, and retaining many of the vegetation attributes of existing unmanaged stands (residual green trees, snags, and down logs) in managed stands. These strategies provide increased dispersal opportunity.

The potential for severe adverse consequences from escaped slash burns or wildfire increases over time. Landscapes dominated by young, even aged stands with inclusions of mature or old growth islands will be more susceptible to crown fires and catastrophic loss of suitable habitat islands. Increased amounts of small dead and downed woody debris left untreated in harvest units increases the potential for fire ignition within individual managed stands during the decade following harvest. Large down woody material maintains a high moisture content and will not necessarily increase the risk of wildfire.

The potential to replace of network habitat areas following catastrophic events would be very limited in Alternatives NC, A, J, K, and W (PA) by the third decade. Alternatives D and L provide protection above the MR level, and would provide some opportunity to replace lost habitat.

Pileated Woodpecker: Ecological Indicator Species - Based on habitat capability assessments, potential populations of pileated woodpeckers would decline in all of the alternatives, except L. Most habitat loss will occur during the first five decades. After the fifth decade only those lands allocated to no harvest, or rotations longer than 150 years, would contain suitable roosting or nesting habitat. Alternative D provides the second highest long-term capability, but dispersal between habitat islands could result in a high juvenile mortality rate. Alternative W (PA) provides travel and distribution corridors with a high degree of structural diversity. Potential for successful dispersal between habitat islands would be highest in Alternatives L and W (PA), respectively.

Only Alternative L provides for significant recruitment of suitable mature and old growth habitat in the future. All other alternatives intensively manage most lands suitable for timber harvest on rotations less than 120 years. Although much of the landscape should be suited for dispersal and foraging (age classes greater than 50 years) there is no allowance for replacement stands of suitable nesting habitat in the event of catastrophic event in the habitat islands provided for spotted owls and pileated woodpeckers.

Marten: Ecological Indicator Species - The long-term cumulative effects of the alternatives on the Forest's capability to support a viable population of marten is displayed in Figure IV-11. The rate of decline of the potential population following habitat loss is unknown. The cumulative effects assessment assumed a one decade lag between loss of habitat and subsequent decline in population. This assumption was used because of the likelihood that adult marten would survive in marginal habitat, however, recruitment to the population would be lost as habitat suitable for reproduction diminishes.

Connectivity and distribution of habitat on lands available for timber harvest would not be maintained after the third decade in any alternative but L. The Forest has evaluated the time over which options for minimizing habitat fragmentation can be maintained in Alternative W (PA). After the third decade all planned harvest would have to come from forest stands that were protected in the previous decades. Habitat suitable for dispersal of marten would diminish in all alternatives except L and W (PA). Dispersal capability in Alternative L results from low harvest levels. Alternative W provides habitat features of snags and downed logs Forest-wide at levels capable of providing replacement habitat dispersal and foraging.

After Decade 5, mature and old-growth forest stands would be found primarily on lands unsuited for timber production in all alternatives, except L. These areas include reserved lands, spotted owl, pileated woodpecker and marten habitat areas, special and unique habitats, special interest areas, forested stands on unsuited soils, roadless lands, wild and scenic river corridors, and riparian areas. The number of acres in these allocations varies by alternative, but the rate of harvest applied to the lands suitable and available for timber production would have the same cumulative effect within five decades. Little opportunity would exist to replace habitat lost as a result of catastrophic events.

Potential population trends, projected over 15 decades, indicate that marten populations would remain viable, and suitable habitat would be provided at or above the MR level, in all alternatives, but NC. These trends assume no catastrophic events result in loss of habitat network sites required to maintain suitable habitat distribution and population capability. Loss of these areas would increase isolation of populations. The effect this would have on the viability of marten is unknown.

Primary Cavity Excavators: Ecological Indicator Species - Figure IV-12 displays the cumulative effects of timber harvest on potential populations of cavity excavating species. All alternatives cause a continued decline in distribution, quality, quantity, and recruitment of dead and defective tree habitat. Alternatives D and L provide the highest long-term habitat capability; unit and subwatershed objectives would provide habitat objectives for 60% of potential populations. Alternatives NC and A cause habitat conditions to decline to threshold levels for minimum viability. Habitat capability also decline in Alternatives J, K, and W (PA), but should stabilize near levels capable of supporting 40% potential populations.

Roosevelt Elk and Black-tailed Deer: Featured Species - Management prescriptions for high, moderate, and low habitat emphasis are common to all alternatives. The alternatives vary as to the amount of Forest area managed at each of the three emphasis levels.

Some areas designated for high emphasis would not achieve the habitat effectiveness standards within the first decade. Conversely, areas that are currently above the Forest-wide standards set for low emphasis may not decline to those levels. The current condition of the Forest most closely resembles the Forest-wide standards set for moderate emphasis. The cumulative effects of the proposed management practices would result in an overall decline in habitat capability in Alternatives NC and K. Alternatives A, J, W (PA), L, and D, respectively, provide for increasing habitat capability over time.

The effects of the alternatives, with the exception of Alternative NC, on potential deer and elk populations are evaluated using a population index which is linked with the habitat effectiveness variables described in Chapter III, Wildlife. The habitat effectiveness variables are cover quality, forage quality, open road density, and size and distribution of cover and forage. Cumulative effects are expressed in terms of potential populations of deer and elk when the habitat conditions for one of three levels of habitat emphasis are met.

Cumulative effects on potential populations were calculated based on the number of winter range acres managed at each emphasis levels. High emphasis winter range contributes habitat capability for potential populations of 2 elk and 10 deer per 100 acres. Moderate emphasis winter range contributes habitat capability for potential populations of .8 elk and 4 deer per 100 acres. Low emphasis winter range contributes habitat capability for a potential population of .1 elk and .5 deer per 100 acres. A full description of this modeling process can be found in Appendix B.

Mitigation Measures for Wildlife

Mitigation measures that reduce the effects of disturbing activities to wildlife and their habitats include Forest-wide Standards and Guidelines (S&Gs) for wildlife, prescriptions, operational practices applied during project planning and/or implementation and post-project activities designed to accelerate restoration of desired habitat conditions or attributes. The following discussion of MRs applies to all alternatives with the exception of Alternative NC.

Bald Eagle -- Management Area S&Gs consistant with Recovery Plans objectives reduce the potential for adverse impacts to bald eagles and their habitat. Forest-wide require biological evaluation of proposed activities within potential bald eagle habitat. Mitigation includes establishing protection zones around nest sites, seasonal restrictions to reduce human disturbance during critical times such as breeding, nesting, and fledgling periods, and reducing or eliminating conflicting activities in and around forage areas.

Peregrine Falcon -- Forest-wide S&Gs reduce the potential for adverse impacts to peregrine falcons. Direction includes the protection of potential nest sites, protection of special and unique habitats, and biological evaluation of activities which may affect peregrine falcon habitat.

Spotted Owl -- Standards and Guidelines established in Amendment to the Pacific Northwest Regional Guide were followed to ensure appropriate size and distribution of spotted owl habitat areas (SOHAs) throughout the Forest. All SOHA acres were removed from lands suited for timber production. No harvest will be allowed within the SOHA boundaries. Additional protection is provided for pairs of spotted owls located outside SOHAs through the use of Forest-wide S&Gs.

Pileated Woodpecker -- Management requirements for pileated woodpecker habitat are met by establishing Management Area direction. This direction is provided in the S&Gs specific to the management area.

Marten -- Management requirements for marten are met by establishing Management Areas direction. This direction is provided in the S&Gs specific to the management area.

Primary Cavity Excavators -- Forest-wide S&Gs incorporate management requirements that will provide sufficient number, distribution, and size of dead and defective trees to maintain habitat for snag dependent species capable of supporting 40% of potential populations within each subwatershed.

Deer and Elk -- Habitat management focuses on cover quality, forage quality, security, and size and distribution of cover and forage. Management emphasis varies depending on the alternative. Direction for meeting habitat effectiveness values within emphasis areas is provided through Forest-wide S&Gs.

Monitoring questions have been prepared to evaluate the implemantation and effectiveness of the S&Gs. Validation monitoring has been proposed to address the assumptions used to predict effects to habitat and populations.

Information needs have been documented to address the need for inventories and research pertaining to specific plants, wildlife, and habitats.

Relationships with Other Agency Plans or Policies for Wildlife

Management for peregrine falcons will be in accordance with the Pacific Recovery Plan for the American Peregrine Falcon (1982) and the Endangered Species Act of 1973, as amended. In a cooperative effort with the ODFW, 12 potential peregrine nest sites were identified. If presence of a nesting pair is verified, the Forest will proceed to develop site specific management plans for the area in cooperation with the USDI Fish and Wildlife Service and Oregon Department of Fish and Wildlife.

Management of bald eagles and their habitat will be in accordance with the Pacific States Bald Eagle Recovery Plan. Additional requirements for management of occupied territories will be based site specific management plans developed in cooperation with the U.S. Fish and Wildlife Service and Oregon Department of Fish and Wildlife.

Under all alternatives habitat for the spotted owl will be provided on Federal lands adjacent to the Forest. The Mt. Hood, Umpqua, and the Deschutes National Forests along with the Salem and Eugene BLM Districts will provide habitat linkages. The private lands adjacent to the Forest have been heavily harvested and will provide little to no spotted owl habitat within the planning horizon. The contribution of spotted owl habitat on private lands within and adjacent to the Forest is expected to be minimal as old-growth stand characteristics will not be achieved on planned harvest rotations.

Under all alternatives, with the exception of Alternative NC, a systematically spaced distribution of marten and pileated woodpecker habitat will be provided on the Forest in coordination with adjacent Forests to ensure proper distribution of habitat. Private lands within and adjacent to the Forest have been heavily harvested and are expected to provide little to no marten or pileated woodpecker habitat within the planning period.

Region Six policy directs management of Primary Cavity Excavator Habitat to exceed 40% biological potential (FSM 2600). ODFW recommends 60% biological potential as the appropriate management level for primary cavity excavators. All alternatives, except NC and A, meet the Region 6 objectives, with Alternatives D and L meeting the 60% objective. Potential populations were not determined for Alternative NC.

Both the ODFW and the Forest are currently involved in a cooperative agreement to determine elk population trends, herd composition, and habitat use through an elk collaring and monitoring program. Alernatives were designed to evaluate the potential for meeting ODFW population benchmarks for deer and elk.

Incomplete or Unavailable Information on Wildlife

Territory size and habitat use of pileated woodpeckers and marten within the Cascades Province of Oregon.

Dispersal distances between habitat areas required to ensure long-term population viability for all Management Indicator Species.

Inventories of Sensitive species populations throughout the Forest.

Availability, distribution, recruitment, and fall down rates of dead and down trees in managed and unmanaged forest stands.

Biological role of old-growth Douglas fir forests in the winter survival of deer and elk populations.

Quality and amount of forage produced in seral stages of plant community development with and without treatment with prescribed fire.

Environmental Consequences Of The Alternatives On Recreation

Recreational settings occur throughout the Forest and provide a range of recreation opportunities. Changes in the characteristics of these settings affect the recreational experience of the Forest visitor. Recreation settings for both developed and dispersed use are affected by a number of management activities including those that alter plant and wildlife habitat, remove vegetation, expose soil, alter landforms, change water levels, and increase or decrease access to the National Forest land.

Numerous dispersed recreational settings are located throughout the Forest, from the densely forested areas of the Western Cascades to the meadows and alpine lakes of the Cascade Crest. Over 1,286,000 acres provide a broad range of potential dispersed recreation opportunities, in addition to those available in Wilderness. Dispersed recreation users are attracted to the Forest because of road and trail access, the presence of fish and wildlife, the scenic quality of the landscape, and its diversity of recreation settings.

People are drawn to the developed recreation sites in the Forest for many of the same reasons, including accessibility, availability of facilities, proximity to water, and attractiveness of their surroundings. Developed sites range from ski areas where facilities are provided to enhance recreational experiences and user comfort, to developed primitive campsites where facilities are provided only for the protection of basic resources. Although developed sites are relatively small, distinctly defined areas where facilities are provided for concentrated public use, the characteristics of adjacent areas also contribute to the quality of a developed recreation setting.

Direct and Indirect Effects of the Alternatives on Recreation

The management areas proposed by the alternatives will determine the location and type of recreational settings that will be available in the future. The proposed alternatives will affect recreation settings, trails, and the level of use of both dispersed and developed recreation opportunities. This will affect the capability of the Forest to meet present and projected demand for various types of recreation experiences. Alternative levels of recreation program funding also have an impact on the quantity, quality, and utility of recreational settings, especially as related to changes in the Recreation Opportunity Spectrum (ROS) inventory acres and resultant use capacity of the Forest. The capacity of recreational settings to sustain projected levels of demand is measured in Recreation Visitor Days (RVDs).

Dispersed Recreation Settings - Settings for dispersed recreation are primarily affected by activities that alter the physical character of the landscape, such as road construction, timber harvest, and mineral and energy development. The extent to or manner in which the landscape is altered will affect each ROS setting differently.

Semiprimitive settings, both motorized and nonmotorized, are affected to the greatest extent by landscape altering activities. In the roaded natural and roaded modified setting, road construction and timber harvest are normal occurrences; however, setting activities are designed to ensure a specified level of scenic quality and recreation experience. Although semiprimitive motorized and nonmotorized settings can absorb small, carefully designed alterations, activities typically associated with roaded natural and roaded modified settings would preclude satisfaction of user needs for isolation, solitude, and primitive type recreation in these settings. In addition the influences of road construction and timber harvest activities in near proximity to semiprimitive settings can reduce the effective size of these settings. Also the presence of noise and the visibility of timber harvest operations detract from and thus can further diminish this experience opportunity.

The effect on settings for dispersed recreation is illustrated by the disposition of each ROS class setting in the alternatives. Depending on which management areas are applied in the alternatives, all or part of a given ROS Class may be managed for an opportunity that is different than its inventoried potential. Table IV-21 displays how each inventoried ROS setting would be managed by alternative.

Table IV-21. Effects on Inventoried Dispersed Recreation Opportunity Settings

ROS Inventory			Alternatives [1]						
Classes	Acres	Proposed Manage-ment	NC	K	A	J	W	D	L
Semiprimitive	205,335	SPN	26	4	25	30	29	62	61
Nonmotorized	SPM	4	14	4	5	6	8	2	
(SPN)									
		RN	11	18	21	23	24	17	36
		RM	59	64	50	42	41	13	1
		Total	100	100	100	100	100	100	100
Semiprimitive	43,300	SPN	24	0	21	35	34	65	74
Motorized (SPM)	SPM	15	23	14	16	17	9	1	
		RN	10	29	24	17	20	11	24
		RM	51	48	41	32	29	15	1
		Total	100	100	100	100	100	100	100
Roaded	437,615	SPN	1	0	1	2	1	3	12
Natural (RN)	SPM	1	1	1	2	3	3	7	
		RN	27	36	39	48	50	65	68
		RM	71	63	59	48	46	29	13
		Total	100	100	100	100	100	100	100
Roaded	600,120	SPN	0	0	0	0	1	1	11
Modified (RM)		SPM	1	1	1	1	1	1	5
		RN	3	11	12	15	17	18	58
		RM	96	88	87	84	82	80	26
		Total	100	100	100	100	100	100	100

[1] Values are percent of inventoried non-Wilderness ROS acres.

Semiprimitive Non-motorized - Alternative K has the greatest effect on semiprimitive nonmotorized (SPN) recreation settings. In this alternative 82% of the SPN is proposed for management as roaded natural (RN) and roaded modified (RM) opportunities. The SPN settings managed for RN and RM opportunities will, in 5 to 10 years, be altered dramatically by roads and harvest units, and thus unable to provide for user needs of isolation, solitude, and primitive type recreation in an un-modified natural environment. Alternatives D and L maintain 61% and 62% respectively the Forests inventoried SPN settings.

Semiprimitive Motorized - Of all the alternatives, D and L have the most favorable effect on semiprimitive motorized (SPM) recreation settings, maintaining 61% and 75% respectively. Alternatives D and L, through management area allocations that provide both motorized and nonmotorized use in undeveloped areas, also maintain 74% and 75% of inventoried SPN settings, respectively. Alternatives NC, K, and A propose management of between 61% and 77% of the Forest's semiprimitive motorized recreation setting for roaded natural and roaded modified opportunities; while this change from unroaded opportunities to roaded recreation does not preclude motorized use, it does limit dramatically off-road vehicle use opportunities in undeveloped settings.

Roaded Natural - Inventoried roaded natural settings are affected most adversely in Alternatives NC, K and A as between 59% and 71% of this opportunity setting is proposed to be managed as a roaded modified setting. The frequency and design characteristics of management activities in the roaded modified setting will result in an obviously altered, rather than a natural appearing landscape, typical of the roaded natural setting. Alternatives D and L would have the most favorable effect on the roaded natural setting as they maintain 65% and 68% respectively, of the Forest's inventoried potential.

Roaded Modified - Opportunities for recreation use in a roaded modified setting are maintained to a significant extent of inventoried potential (80%-96%) in all alternatives except, Alternative L. Minor amounts of this inventoried opportunity setting are proposed for management as roaded natural and semiprimitive settings. Alternative L proposes that 74% of the RM setting would be managed as RN, SPM and SPN settings.

Oregon Cascades Recreation Area (OCRA) - The OCRA is a unique recreation setting within the Forest that provides semiprimitive recreation opportunities. The OCRA was established by the Oregon Wilderness Act of 1984 to conserve and protect a wide array of natural resources and landscape attributes, and provide for use of both developed and dispersed recreation settings including motorized access and use opportunities. The portion of the OCRA managed by the Forest encompasses the Timpanogas Basin, located 45 miles southeast of Oakridge, Oregon.

While the alternatives have no effect on the location of boundaries, or the size of the OCRA, they do effect how the area is proposed to be managed. Effects on the environment of the area are expected to be minor as no programmed timber harvest or road construction is permitted. Effects to the physical resource are anticipated primarily from human use, such as soil displacement, compaction of camp areas, trampling of ground cover vegetation, and increased littering. The degree of effect on the resources would vary among the alternatives. Alternatives that permit motorized use of the area will have a greater effect on the recreation setting of the OCRA than those that exclude such use. Table IV-22 displays OCRA proposals for managing motorized and nonmotorized use in each alternative.

Alternatives K and L are expected to have the least effect on the physical resources of the OCRA as motorized use is excluded from the area, except in winter under Alternative K. The greatest potential effect to the area's resources is expected from Alternatives NC and A as motorized use is permitted throughout the OCRA. Effects of Alternatives J, W (PA) and D are expected to occur primarily in motorized trail zones and dispersed camping areas.

Dispersed Recreation Use and Demand - Dispersed recreation use Forest-wide currently totals 1,480,900 recreation visitor days (RVDs). User demand for this form of recreation use is expected to increase to 3,980,600 RVDs by the year 2040. The Forest's inventoried capacity to accommodate future use exceeds expected use levels in 2040 by 21%. Although total use in dispersed recreation activities may not be particularly sensitive to changes in management allocations, use that is dependent on a specific recreation setting would,however, be affected by such changes in the alternatives.

RVD outputs for the NC Alternative are not available for comparison on an ROS class basis. However, outputs for total dispersed recreation use for the NC Alternative are shown and compared with other alternatives in the Resource Program section of Chapter II.

Table IV-22 Management Options for Motor and Nonmotor Use of the OCRA [1]

	Alternatives						
	NC	K	A	J	W	D	L
UNDEVELOPED AREAS							
All Seasons	M/N	N/S	M/N	N/S	N/S	N/S	N
TRAIL ZONES [2]	M/N	N/S	M/N	M/N	M/N	M/N	N
All Seasons							

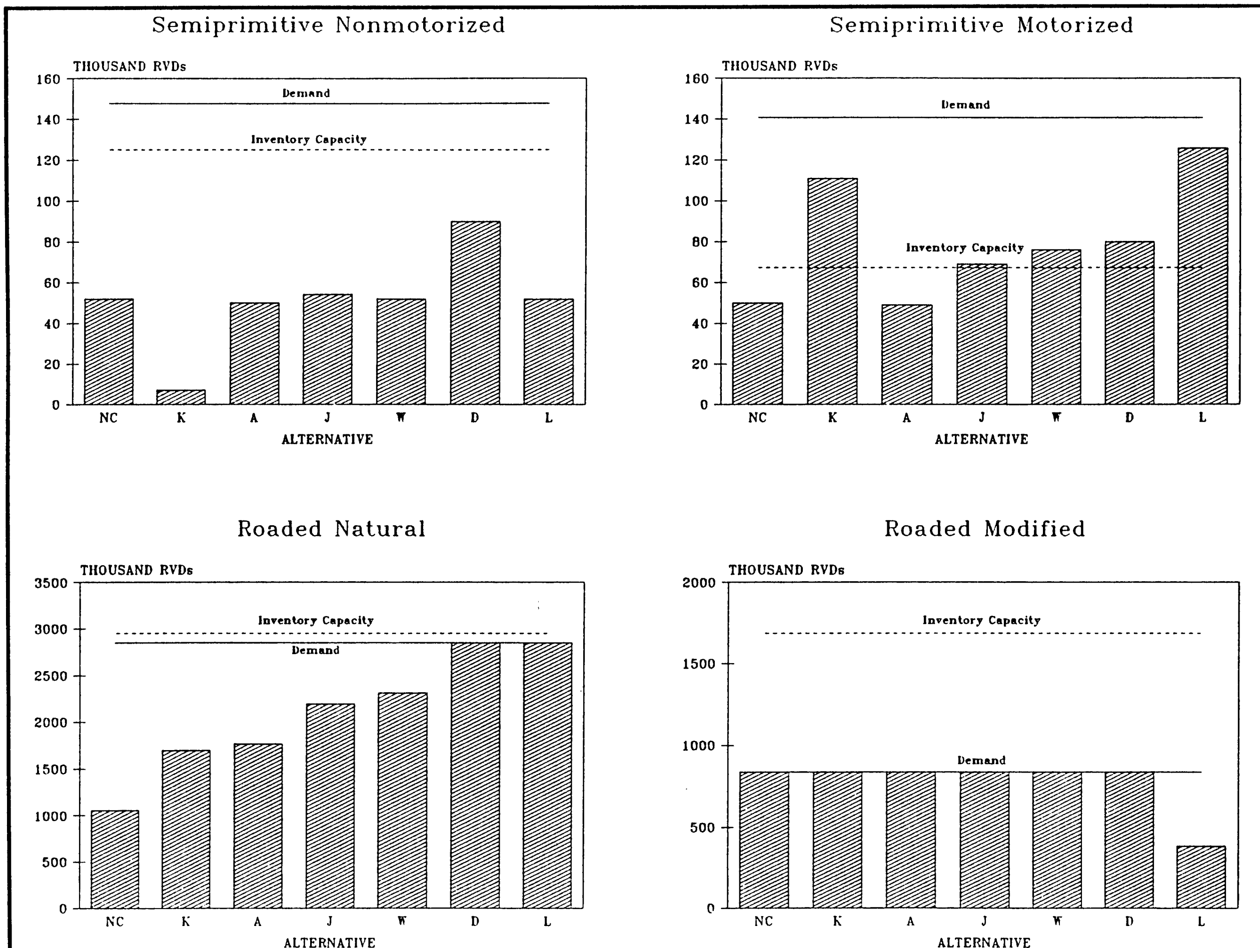
[1]M/N = Motorized and Nonmotorized use.
N = Nonmotorized use.
N/S = Nonmotorized use with winter only motorized use.
[2] The Pacific Crest National Scenic Trail is closed to motorized use all year.

Because of the changes to settings for dispersed recreation described above and illustrated in Table IV-21, the Forest's ability to satisfy user demand for semiprimitive and roaded natural settings is limited in some alternatives. However, future demand for roaded modified opportunities is fully satisfied in all alternatives. Figure IV-13 illustrates the extent to which each alternative would satisfy user demand for each ROS setting.

The public's desire for use in semiprimitive nonmotorized recreation settings is best provided for in Alternative D. This alternative proposes to supply 61% of expected user demand in the year 2040. Alternative K has the greatest effect on supplying semiprimitive nonmotorized use opportunities by accommodating 6% of the demand expected in the year 2040. Other alternatives supply between 34% and 35% of future demand.

User demand for semiprimitive motorized recreation opportunities is provided for to the greatest extent in Alternatives K and L. Alternative L supplies 89% of demand while Alternative K provides 79% of 2040 demand. Alternatives J, W (PA) and D provide between 50% and 57% of use expected in the fifth decade (2040). Other alternatives provide between 34% and 35% of 2040 demand.

Figure IV-13 Effects on Dispersed Recreation Use [1]



			Alternatives [1]						
ROS CLASSES	**2040 RVD**	**Demand[2]**	**NC[3]**	**K**	**A**	**J**	**W**	**D**	**L**
Semiprimitive Nonmotorized	Demand	147.8	35	5	34	37	35	61	35
Semiprimitive Motorized	Demand	140.9	36	79	35	50	54	57	89
Roaded Natural	Demand	2,852.7	37	59	62	77	81	100	100
Roaded Modified	Demand	839.2	100	100	100	100	100	100	100

[1] Alternative outputs are percent of 5th decade RVD demand provided.
[2] Values are in thousands of RVDs.

The Forest's ability to satisfy demand for semiprimitive motorized and nonmotorized use in any of the alternatives is limited by inventoried capacity. Forest capacity is about 85% of demand for nonmotorized use and 31% of demand for motorized use. To satisfy 2040 demand for semiprimitive motorized and nonmotorized use, would require rehabilitation of roaded natural and roaded modified settings over a period of 30 to 50 years.

The public's desire for roaded natural recreation settings is accommodated at a high level in Alternatives J, W (PA), D and L. Alternatives D and L supply 100% of 2040 demand while Alternatives J and W (PA) accommodate 77% to 81% of future demand. The lowest response to public demand for this recreation setting is provided by Alternative NC by supplying 37% of 2030 demand. Other alternatives provide between 59% and 62% of future demand for the roaded natural setting.

Public demand for use of roaded modified opportunities in the year 2040 is fully satisfied in all alternatives.

Trails - Management areas, each with specific goals and standards applied in the alternatives, will have differing effects upon the trails located within them. However, groups of management areas may be expected to have some common characteristic effects on Forest trails. The most significant effects of management area activities on nonwilderness trails are due to timber harvest and road construction. Trails which traverse management areas having a high incidence of timber harvest and road construction are more subject to the effects of replacement and bisection by roads, and the encroachment of management activities on the visual experiences of trail uses than management areas with a lower incidence of these activities.

The removal of trees along trails through various harvest methods and associated post harvest practices will alter the basic character of trail settings and may displace trail use. During harvest and post harvest operations affected trail segments will become impassable or destroyed. The felling of trees, yarding, and residue treatment activities can block access of users and destroy or disturb trail surfaces. These effects will typically result in closures of affected trail segments, trail relocations and reconstruction of disturbed trail surfaces.

Road construction continues to have the greatest effect on the Forest trail system. As the Forest road network expands, more and more trails will be bisected or replaced. Bisection of trails interrupts an otherwise continuous trail-related experience or opportunity of both motorized and nonmotorized use. Often roads that bisect trails result in a shortened distance to a trail's destination. Trail replacement through road construction often results when a new road actually occupies the same grade and alignment of a trail, obliterating any evidence of its existence and providing access to the same destination.

A further consequence of replacement and bisection of trails, is the loss of trail related recreation opportunities and displacement of trail users. Extension of the Forest's road system has and may continue to shorten access and attract more use to many special areas and natural features resulting in increased compaction, displacement, and erosion of trail surfaces. In addition, as trail mileage is reduced from bisection and replacement, competition among mountian bikers, hikers, motorized trail bike users, and pack and saddle users for exclusive use is likely to increase.

Actual impacts to trails from timber harvest and road construction will be on a site specific basis. Effects cannot be determined until locations of harvest units and road segments are known. However, by comparing for each alternative the miles of Forest trails in management areas that permit timber harvest and road construction, with proposed harvest areas, the relative potential effect of each alternative can be assessed.

To illustrate the relative effect each alternative has on the Forest's existing trail system, management areas have been grouped into three categories, based upon their potential to affect trails. Table IV-23 illustrates the effects of the alternatives on trails based on these management area groupings.

Table IV-23 Effects on Existing and Potential Forest Trails in Miles

		Alternatives						
Effect Category [1]		NC	K	A	J	W	D	L
High	Existing	314	343	278	200	77	136	28
	Potential	38	83	83	171	231	204	315
Moderate	Existing	236	243	221	207	243	178	186
	Potential	199	121	193	160	171	133	127
Low	Existing	164	128	215	307	394	400	500
	Potential	315	348	276	221	150	215	110
TOTAL	Existing	714	714	714	714	714	714	714
	Potential	552	552	552	552	552	552	552

[1] **High** = Management areas with normal harvest levels and attendant road construction.
Moderate = Management areas with reduced harvest levels and limited road construction.
Low = Management areas with no programmed harvest and no road construction.

As illustrated in Table IV-23 each alternative will affect exisiting and potential miles of trails differently. Generally, alternatives that include more trails and potential trail locations within management areas that exclude or permit only low levels of timber harvest or road construction will maintain trail corridor environments in natural or natural appearing conditions. Alternatives J, W (PA), D and L maintain between 307 and 500 miles of existing trails and between 171 and 315 miles of potential trails locations in management areas that assure the protection of trail related values and experiences. Other alternatives, such as NC, K and A propose maintain 164 and 215 miles of existing trails and between 38 and 83 miles of potential trail locations in a similar manner.

Opportunities for mountian bike use, hiking, pack and saddle use, and trail bike use would be increased in some alternatives through construction of new trails. Alternatives W (PA) and D propose construction of 60 and 68 miles of new trails respectively, while Alternatives J and L propose 40 miles each. Alternatives NC, K, and A propose no new trail construction.

Off-Road Vehicles - The primary areas of off-road vehicle (ORV) use in the Forest include Santiam Pass, Willamette Pass, and the Oregon Cascades Recreation Area. Other areas of use include the upper reaches of the Middle Fork of the Willamette drainage and, during drawdown periods, the mud flats of Lookout Point and Hills Creek reservoirs. The proposed alternatives vary in their effect on the availability of recreation settings for ORV use. Since each management area either permits, restricts, or excludes ORV use, the type and distribution of management areas in each alternative will affect directly the location and amount of area to be provided for ORV opportunities. Management area 14a (General Forest) provides the greatest amount of area for this type of use opportunity. Table IV-24 illustrates the status of ORV opportunities in each of the proposed alternatives.

Table IV-24 Effects on Off-Road Vehicle Opportunities [1]

	Alternatives [1]						
	NC	K	A	J	W	D	L
Open	69	63	61	59	57	54	38
Restricted	1	7	6	6	6	5	3
Closed	30	30	33	35	37	41	59
TOTAL	100	100	100	100	100	100	100

[1] Values reflect percent of total Willamette National Forest acreage.

Management areas or portions of areas that restrict ORV use typically limit use during specified periods to reduce conflict with other uses and protect resources. Access to some areas of the Forest is controlled by season to avoid impacts to highly erosive soils, big-game calving and winter areas, threatened and endangered species habitats, and other types of seasonally dependent recreation use.

A reduction in the amount of area or miles of trail available to ORV use and subsequent displacement of use has several effects. Expected effects on remaining ORV areas include higher per acre use densities and increased potential of resource impacts. The potential for conflict among users is also expected to increase, particularly in those areas highly suited to some forms of nonmotorized recreation use such as cross-country skiing.

Alternatives NC and K increase from 2% to 8% the amount of Forest area open to ORV use over current levels. All other alternatives decrease the amount of Forest area available for ORV use from 2% to 23% below current levels.

Developed Recreation - Alternatives may affect developed recreation settings in three basic ways: by the elimination of sites, by the manner in which individual sites are maintained, and by the type of management that is proposed to surround individual sites.

The elimination or closure of some developed sites may affect other sites. The users of sites proposed for closure will be displaced into other developed sites, or will seek alternative experiences in undeveloped dispersed sites. Subsequent effects include: the possible overuse of other developed sites, the loss of a preferred user experience, and the increased potential of human-caused wildfire in dispersed camping sites. In addition, an increase in litter, human waste, vandalism, and related effects can be expected in dispersed sites.

An increase in the number of sites will provide for a growing demand for some forms of developed recreation, tend to reduce overcrowding and overuse of existing sites, and offer a more diverse range of opportunities. Table IV-25 illustrates the number of sites proposed by management sector in each of the alternatives.

Table IV-25. Effects on Developed Recreation Opportunities [1]

		Alternatives [1]						
Management Sector	Current Inventory	NC	K	A	J	W	D	L
Public Sector	174	174	214	174	178	199	188	174
Private Sector	30	30	44	30	41	36	34	30
TOTAL	204	204	258	204	219	235	222	204

[1] Values are expressed as number of sites.

As illustrated in Table IV-25, the alternatives would affect the availability of both public and private sector sites. Alternatives K, J, W (PA) and D increase the total number of developed sites by 54, 15, 13, and 18 respectively, over current inventory levels. Alternatives NC, A, and L propose maintainingdeveloped sites at current levels. In addition to increases in total number of new sites among some alternatives, the emphasis between public versus private sector management shifts among some of the alternatives. Alternatives K, J, W (PA), and D propose increasing the number of developed recreation sites to be managed by the private sector from 30 to 44, 41, 36, and 34 respectively.

Actual management of individual sites is based upon their assigned service level for operation and maintenance. The level of service assigned is based on use capacity, site protection needs, and seasonal demand for public use. Sites assigned to a less than standard service level of maintenance, as compared with sites that are managed at the standard service level, will not be provided with law enforcement patrols, garbage pickup, potable water, grounds cleanup and brushing, or sign maintenance. However, safety hazards will continue to be minimized and no fees will be charged for use of less than standard service sites. The frequency of other site maintenance activities, such as sanitation, will be reduced from a daily to a weekly occurrence.

Likely consequences of these actions include a potential increase in rodent populations, reduction in aesthetic appearance of sites, and the need for users to pack out their own garbage, and provide their own water and toilet supplies. Table IV-26 illustrates the relationship of less than standard service sites to standard service sites in each alternative.

Table IV-26. Proposed Management of Developed Recreation Settings

		Alternatives [1]						
Operation and Maintenance Levels	**Current Inventory**	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Standard Service	122	122	176	122	137	153	140	122
Less than Standard	82	82	82	82	82	82	82	82
TOTAL SITES	204	204	258	204	219	235	222	204

[1] Values are in number of sites.

As illustrated in Table IV-26, the alternatives would affect the operation and maintenance levels of developed recreation settings. Operation and maintenance levels of developed sites change only for the standard service level among the alternatives.

Alternatives K, J, W (PA), and D all increase the number of sites to be managed at the standard service level. Increases over current levels range between 15 and 54 sites. Alternatives NC, A, and L maintain standard service site management at current levels. The number of sites to be maintained at a less than standard service level remain the same among all alternatives.

Timber harvest and road construction activities in areas surrounding developed sites could affect the setting of those sites and the experience of users if activities affect the developed area or if users venture beyond the sites into the surrounding landscape. In either case, harvest activities can change the character of the surrounding area in a manner that may preclude experiences and opportunities typically associated with developed site use, or in the vicinity of developed sites, such as hiking, fishing, sightseeing and nature study.

Road construction and harvest activities could result in increased sedimentation affecting fish habitat and fishing quality. These activities can also result in a heightened sense of industrial activity in the area from increased noise levels and, therefore, a reduction in the quality of the overall recreation experience.

The alternatives provide a high degree of protection for the settings of both existing and proposed developed recreation sites from surrounding management influences. Most sites are surrounded by management areas that permit only low levels of harvest and road development and, are therefore, buffered from the normal effects of forest industrial operations. Alternative K provides the least protection for developed settings from surrounding influences, while alternatives D and L provide the most.

The effects of the alternatives on the Forest's ability to satisfy user demand in the future is based on the total number of sites provided and their inherent use capacity. Furthermore, the ability of the Forest to provide for some increases in types of developed recreation use, such as downhill skiing, is based on whether new development or expansion of existing sites is proposed. Table IV-27 illustrates the total number of developed sites to be provided by each alternative and the percent of expected 5th decade (2040) demand they would provide.

Table IV-27. Effects on Managed Sites and User Demand

Category	Current Inventory	Alternatives [1] NC	K	A	J	W	D	L
Existing Sites	204	204	204	204	204	204	204	204
Proposed Sites	0	0	54	0	15	31	18	0
TOTAL SITES	204	204	258	204	219	235	222	204
RVD DEMAND [2]	57%	57%	100%	57%	62%	69%	63%	57%

[1] Values are expressed as number of sites.
[2] Alternative values are in percent of 2040 RVD demand; 4,481,300 RVDs.

As indicated in Table IV-27, Alternatives A, J, and L supply between 57% and 62% of developed recreation demand expected in the year 2040, while Alternative K provides 100%; W (PA), 69%; and L, 85% of expected future demand.

Within the spectrum of developed recreation opportunities that the public desires, downhill skiing is the most significant in terms of required facilities, capital investment, and development area; however, it represents only about 3% of the total estimated demand for developed recreation use. Projected annual user demand for downhill skiing in 2040 (117,100 RVDs) is accommodated with existing facilities. However, permit areas for both Hoodoo Ski Bowl and Willamette Pass Ski Area have been enlarged to develop additional capacity to provide expanded opportunities during peak use periods, currently limited by installed lift capacity. All alternatives provide for expansion of Hoodoo Bowl and Willamette Pass Ski areas.

Cumulative Effects on Recreation

As natural settings are altered through timber harvest and road construction, the capacity of the Forest to provide some types of dispersed recreational settings and experiences is diminished. The greater the shift from unroaded recreation to roaded recreation in the alternatives, the greater the cumulative effect on semiprimitive (motorized and nonmotorized) recreation opportunity settings. Alternative K will have the greatest effect on this type of setting as only 21% of potential will be provided. Alternative D would have the least effect as 71% of inventoried potential will be maintained. Other alternatives would maintain between 32% and 66% of the Forest's semiprimitive opportunity settings.

Another effect of managing recreational settings is that over time, some characteristics of developed sites are lost as a consequence of recreational use and maintenance, and sites take on a "well groomed" appearance. This effect, coupled with limited new site development, would narrow the range of developed recreation setting opportunities by stratifying them at a high level of development

Alternatives NC, A, and L have the greatest effect by narrowing the range of developed recreation settings available for public use. Alternatives K, J, W (PA) and D have the least effect, as they increase the total number of sites and broaden the range of available developed recreation settings.

As road construction and timber harvest activities are implemented over several decades, they have the potential to affect an increasing amount of trail mileage. The effects of bisection and replacement are greatest in alternatives NC, K, and A. Alternatives W, D, and L are likely to have the least effect as fewer miles of trail are exposed to future road construction and timber harvest activities.

Mitigation Measures for Recreation

The quality of recreational settings in the Forest would be managed in all alternatives through the application of standards and guidelines which apply to all management activities. Relative to the type and level of recreation use, mitigation measures consist of a broad scope of actions that avoid, minimize, rectify, reduce, or compensate for environmental impacts.

The effects of intensive Forest management activities, such as noise and visibility of activities and equipment adjacent to semiprimitive settings can be mitigated by: limiting the proximity of roads; modifying the extent or nature of proposed activities; and scheduling activities during periods of low public use.

Transportation systems and roads affect access to and impacts on both dispersed and developed recreational settings in the Forest. Uncontrolled off-road vehicle (ORV) use increases the risk of degrading the recreational experience because of damage to vegetation both within and adjacent to designated use areas. The risk of damage can be lessened through area controls and public contact. Area improvement and rehabilitation plans and projects can be developed and implemented by groups of ORV users.

In some situations, the effects of crowding on campsites and trail systems can be reduced by dispersing recreation use into other areas where timber harvest is not active. Road closures in these areas can make additional settings available to recreationists who do not object to hiking and camping where there is evidence of harvest activity.

To maintain semiprimitive experiences, group sizes would be regulated, campfires may be limited to designated areas, and visitor contacts would be made by Forest officers to ensure compliance with established management standards and permit requirements.

Losses of trail systems as a result of timber harvest can be offset by alternate ways of locating and scheduling road construction and the cutting of harvest units. In some areas there is also the potential for relocating trails, rehabilitating older, nonmaintained trails, or rehabilitating trails in place after timber harvesting is complete to supplement access.

Increased use of trails and dispersed campsites where there are no sanitary facilities would be accompanied by increased levels of human waste. If trails or dispersed campsites are located near water features, the risk of reduced water quality is increased. The location and magnitude of this effect is lessened by backcountry ranger contact with users, toilet facilities to protect resources and human health and safety, and if necessary, area closures.

As a result of providing recreational opportunities in a visually appealing and safe forest setting, there are impacts on vegetation and timber resources. In developed sites, selected silvicultural practices would be utilized to protect vegetation from insects and disease, perpetuate healthy vegetation, and establish viable vegetative cover. Diseased or hazardous trees located in recreation sites or along trails may be removed for the safety of Forest users.

Because dispersed activity can significantly disturb soil, duff, litter layer, and vegetation, Forest guidelines for all the alternatives set standards for dispersed campsites and prohibit camping within a 100 feet from lakes, streams, trails and key features. The use of camping sites near streams or lakes concentrates fishing pressure, decreases fishing success, and reduces riparian vegetation by trampling. Increased motor vehicle activity and/or use of pack and riding stock near water courses and lakes can cause erosion, sedimentation, and degradation of fish habitat. These effects can be mitigated by limiting times of use to avoid periods when the ecosystem could be unacceptably damaged. Mitigation could also include site rehabilitation, seasonal and permanent road and/or area closures, and restrictions on dispersed campsite locations.

Developed recreation sites are vulnerable to both costly vandalism and overuse, which can adversely effect facilities, soils, vegetation, and aquatic resources. Measures used to mitigate these impacts, if they occur, include site rehabilitation, re-distribution of use into underutilized sites, scheduling shorter use seasons, raising fees, and concentrating funding on cost effective developed sites. Proposed recreation sites, as in Alternatives K, J, W (PA), and D, would have comprehensive and detailed plans prepared in accord with requirements specified in Forest Service Manual 2330 (Recreation Management) before construction or expansion would occur.

Relationships With Other Agency Plans or Policies for Recreation

State and local planners, and members of the private sector, recognize the importance of recreational settings to both the tourist industry and the local economy. In response, some local communities are beginning to promote year around tourism as a means of diversifying their economic base. The State Tourism Council is also pursuing destination point futures for Oregon. Toward this end some communities may become increasingly dependant upon the Forest and it's varied resources to attract visitors.

Although none of the alternatives are in conflict with current Army Corps of Engineers plans, proposed changes in reservoir water levels for Hills Creek and Lookout Point reservoirs by the Army Corps of Engineers may conflict with existing or potential recreation activities and developments. Each proposal will be fully evaluated in regards to the recreation setting on a case by case basis.

Consultation is also made with other agencies such as the Oregon State Division of Parks and Recreation, the Oregon Department of Fish and Wildlife, and the State Historic Preservation Office regarding the management of existing or potential recreational settings. While the effects of implementing any of the alternatives are not expected to conflict with the majority of the objectives identified by these constituencies, a high level of public contact and coordination between the Forest Service and others will be maintained.

Incomplete or Unavailable Information

Information on the factors affecting user demand or activity preferences is insufficient to project or estimate future use levels for recreation activity types and as a basis to effectively scheduling the delivery of recreation services, facilities or opportunities for public use.

Environmental Consequences Of The Alternatives On The Social And Economic Setting

The social and economic environment that surrounds the Forest will be affected as a consequence of implementing any of the proposed alternatives. Change will occur through various direct and indirect effects on the communities, industries, and people that rely on the Willamette for employment, recreation, and other goods and services.

The intent of the Forest Service management was stated shortly after the turn of the century as "the greatest good for the greatest number in the long run." It essentially means that the National Forests were established not for any single group, industry, or individual, but rather for the present and future benefit of the people of the United States. This sort of utilitarian philosophy has been the guiding principle of National Forest management ever since. Thus both local and national issues and concerns are considered in Forest Service policies and decision-making.

Management of Forest resources affects many of the people and communities in Lane, Linn, and Marion counties which make up the Forest's primary area of influence. The alternatives, which show different combinations of management options, will have certain impacts or effects on people who are employed by the Forest Service, those who work under contract for the agency, and businesses that use or renew the many resources of the Forest. The counties receive monies equivalent to 25% of the gross timber receipts (50% on O&C land timber) in lieu of taxes that could be generated from the National Forest land. The counties also receive 25% of the total revenues derived from other resource uses on the Forest, including campground receipts and grazing fees. The Forest also has a direct effect on recreation users, including individuals, families, and organized groups. These people use the Forest for a wide variety of recreation opportunities that vary from Wilderness to developed campgrounds and resorts. The opportunities for participating in these leisure activities vary by alternative.

The socioeconomic environment is affected by changes which are subtle and quite often difficult to measure. These are indirect impacts which include expected changes in secondary employment due to changes in direct employment. Thus, the car dealer or grocery store may be affected by changes in the number of sawmill or Forest Service workers that are employed. Likewise, the employment and projects partially supported by the county monies will have indirect impacts that are real, but difficult to quantify. Feelings of satisfaction with the local area influence citizens beliefs, attitudes, and enjoyment of their work and leisure activities. These are considered to be indirect because of the many other factors that may influence the people in an area more directly. These include home mortgage interest rates, availability of work, hourly wages or salaries, family ties, savings, and amount of leisure time.

The range of alternatives shows considerable variation in the resource outputs that can have an impact on the socioeconomic environment. For example, in one alternative the amount of timber to be sold could be 75% less than current volumes while available recreation opportunities increase. Effects would include a reduction in total jobs and county revenues and potential increases in recreation use if the alternative were implemented. The secondary impacts would also be estimated in terms of the types of businesses that rely on income from timber processing employees, as well as aspects of the community that would benefit through an increase in recreation visits to the Forest.

Effects of the Alternatives on the Social and Economic Setting

There are several basic factors that vary by alternative, with respect to their impact on the socioeconomic environment. They are: (1) jobs, which are heavily influenced by the amount of timber sold and subsequently harvested; (2) income, which is affected by dollar flows throughout the county; (3) payments to the counties which affect county funding, especially for schools and roads; (4) lifestyles, reflected in the amount of recreation opportunities or traditional Native American uses; and (5) community cohesion, which reflects the amount or type of natural resource or Forest management issues which pull together or split the communities.

In addition to the factors that vary by alternative, there are several national social equity concerns that do not vary by alternative. As a public agency, the Forest is committed to the management and development of an organization reflective of the national diversity found in the public we serve. The Federal Small Business Administration (SBA) procedures encouraged small businesses to bid for Forest Service contracts and timber sales. Another Federal program provides for minority and women owned business contracting and encourages participation in the Forest contracting program. The timber sale bidding process allows businesses to be competitive in an open setting.

Federal Equal Employment Opportunity (EEO) and Affirmative Action policies and programs guarantee and encourage equal access to and participation in all Federal resource and employment opportunities. Federal EEO programs include Special Emphasis Programs which advocate the employment and upward mobility of women and minorities in the U.S. Department of Agriculture--Forest Service. These EEO Programs include the Federal Womens Program; the Hispanic Employment Program; the Native American Program; the Human Resource Program, and the Volunteer Program.

Jobs - The Forest has the potential to affect the total number of jobs in its area of influence (Linn, Lane, and Marion Counties) as a result of the mix and level of goods and services provided in each alternative. The assumption in estimates of job impacts is that other supply and demand factors affecting the "markets" for Forest products and uses are constant. This assumption becomes more tenuous the further out in time projections of effects are made. For example, the amount of timber offered for sale by the Forest is not, and will not be, the only factor to affect the number of jobs in the timber industry. Timber supply and demand, thus the number of jobs in the wood products industry are influenced by numerous factors including worker productivity, union and non-union wage and benefit agreements, interest rates for home mortgages and business loans, modernization of the mills, closing of mills that cannot make a profit, import and export levels, production and shipping costs, regional competition, private and public land harvest levels and policies, volatility of the lumber, plywood, and chip markets, and estimating what the availability and price of raw materials and finished products will bring. The analysis of effects in this FEIS is on the comparison of potential first decade changes in the number of jobs for each alternative relative to a base historical level. The base historical level is based on the time period 1980 to 1989.

The number of jobs associated with each alternative was estimated using an input-output model called IMPLAN. In this model, job estimates are a function of changes in final demand resulting from changes in output levels. Changes in output or activity levels initiate expenditures in various sectors of the local economy which trigger the change in jobs and income. On the Forest, job and income effects are based on changes in four major outputs: the amount of timber volume expected to be harvested, recreation use, payments to counties, and Federal government expenditures.

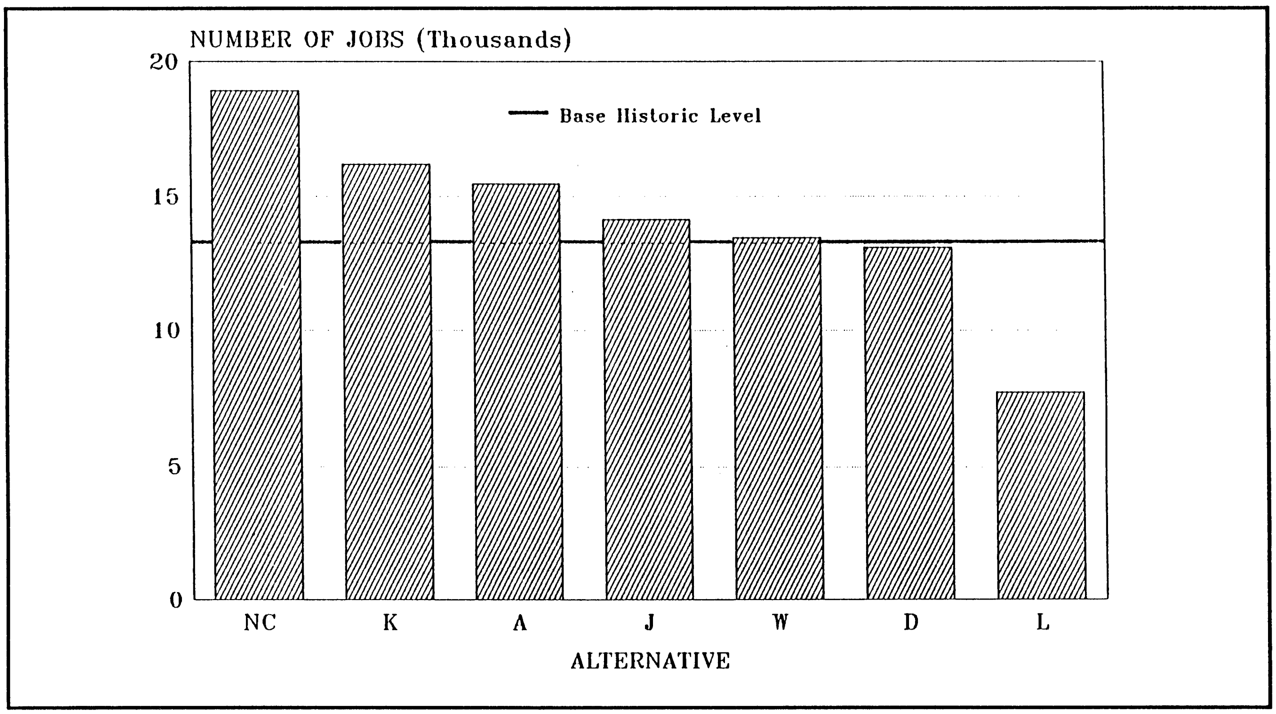
The following discussion of potential changes in jobs will focus on changes in the total number of jobs. To estimate the potential changes in jobs and income associated with each alternative, a base level was established for each output. This base represents a multi-year average of historic output levels between 1980 and 1989. The average number of jobs during this period was 13,257. For more detail regarding assumptions, methods of analysis and alternative outputs refer to Appendix B, *Social Impact Assessment*.

Alternative NC would provide the greatest amount of jobs, approximately 5,654 jobs more than the base level. This reflects a projection of the potential yield for timber in the current Forest Plan (1977) which is significantly higher than the amount actually harvested over the base period. The timber harvest level in the NC Alternative was calculated with a different set of assumptions than were the other alternatives. For more details see Chapter II, *Comparison of Alternatives*.

Alternative K would provide the most jobs relative to the historic level, with nearly 2,945 additional jobs in the first decade. Most of these jobs are related to increased timber harvest. Alternative A would also provide a very high number of jobs with first decade job increases approximately 2,218.

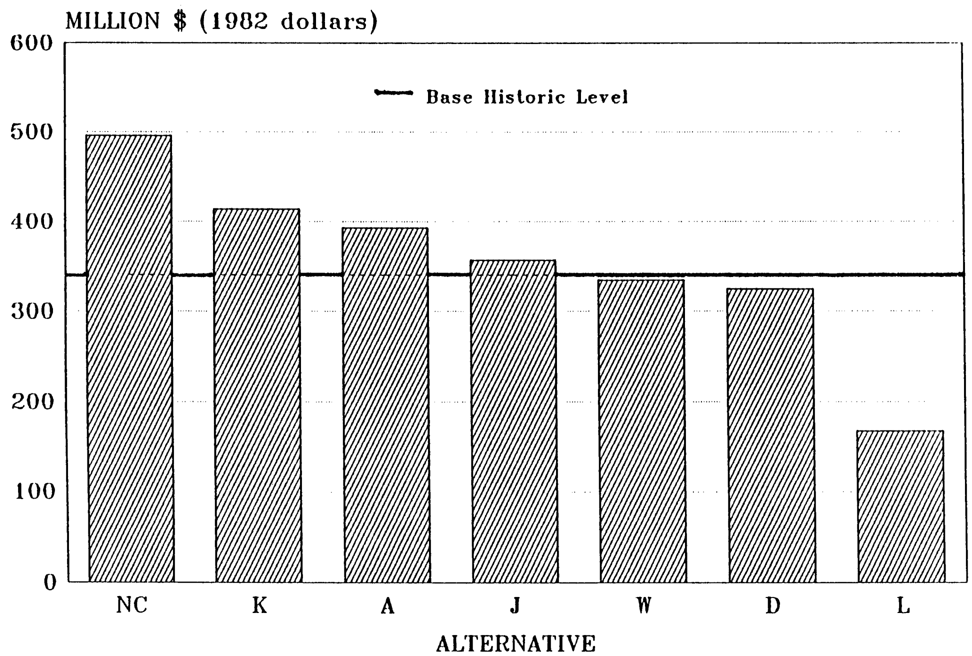
Total employment in the first decade would increase above the historic level in all alternatives except D and L. Total jobs in the first decade would be reduced by almost 167 in Alternative D and 5,499 in Alternative L. These reductions occur primarily because of reduced timber harvest volumes. Though a net increase in jobs is expected, Alternatives J and W would cause a loss of 272 and 815 jobs, respectively, in timber related employment. Recreation related jobs are expected to offset many jobs lost in timber related employment. All alternatives would provide more recreation-related jobs or jobs primarily in the lodging and food industries. Figure IV-20-1 displays the total jobs by alternative and the base historic level. The table associated with Figure IV-20-1 also shows the changes in jobs by alternative relative to the historic base level and relative to the NC Alternative.

Figure IV-14 Total Jobs



Income - Income was also estimated for the first decade with the IMPLAN model and compared to the historic level. Alternatives NC, K, A, and J would increase total income for the first decade. Alternatives W and D would have an income level below the historic level, while total income for Alternative L would fall to 50% of the historical base average. Decreases in total income for Alternative W, D, and L can be best accounted for by the relative decreases in timber related employment. Figure IV-15 displays the total income by alternative and the average base historic level (1980-1989).

Figure IV-15. Total Income



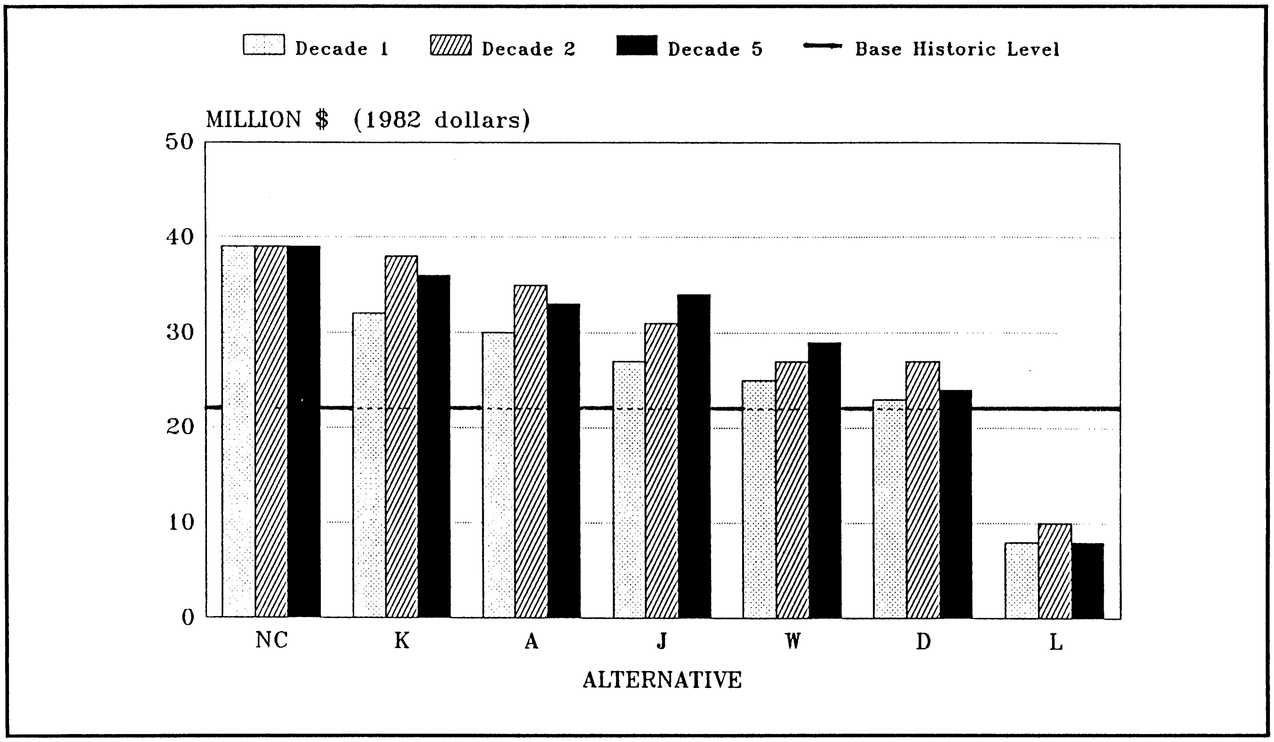
Payments to the Counties - Dollar payments to the counties are based on the 25% formula for uses of National Forest land and resources that generate income for the Federal government. These funds, by law, are to be only used for roads/highways and public schools, while the Oregon and California (O&C) land revenues (which are 50%) can be used for any purpose. The vast majority of these payments come from timber harvests. Thus, when there is a reduction in Forest receipts, the counties must find other sources of revenues to maintain the same funding levels for school and road programs. This could decrease the money available for other programs.

It is recognized that a thorough analysis of the effects resulting from increasing or decreasing timber supply requires an assumption that timber values fluctuate on demand. For example, alternatives that provide reduced timber harvest levels may generate more dollars per unit measure than alternatives producing higher timber harvest levels. However, the complexities involved in estimating supply and demand are beyond the scope of the analysis done by the Forest. The analysis in this FEIS assumes timber values remain constant regarless of supply.

Payments to counties would be above the historic average in Alternatives NC, K, J, and W in the first decade. The returns for Alternatives NC, K and A would be the highest of all alternatives, while in

Alternatives D and L, they are the lowest. Alternative W would be above the historic average (1980-1989). These amounts directly reflect the projected level of timber harvest by alternative and expected value of stumpage. Figure IV-16 displays estimated payments to counties for the first, second, and fifth decades.

Figure IV-16 Payment to Counties



Lifestyles - Lifestyles could be influenced in an alternative by the amount of recreation, hunting, fishing, and visual quality. In terms of the recreation and leisure opportunities on the Forest, all alternatives increase recreation emphasis, with Alternatives K, J, W, and D providing additional new developed sites. All the alternatives provide a wide range of dispersed recreation activities but vary their emphasis as related to diversity of opportunity. Alternatives NC, and A place a moderate emphasis on semiprimitive motor and nonmotorized activities, while Alternative K provides primarily roaded natural and roaded modified recreation opportunities with a minor amount of area provided for semiprimitive opportunities. Alternatives J, W, D, and L provide the most diverse range of recreation opportunities among the alternatives.

With respect to Wilderness, Alternatives W, D, and L provide the highest quality experience opportunities, and the least amount of use during the planning horizon, as a response to conditions of resource damage and over-use in some Wildernesses. Alternative J also provides for higher quality opportunities over current conditions through lower overall Wilderness use levels. Alternatives K and A maintain the current uses and quality of Wilderness and provide for the same levels of expected use in the future.

Alternatives NC, K, and A would maintain the current trail systems while Alternatives J, D, and L provide 40 miles of new trail construction and Alternatives W and D provide at least 60 miles of new trail construction.

Deer and elk hunting opportunities would vary significantly between alternatives. NC would reduce habitat capability for deer and elk and could cause limited opportunity to hunt deer and elk. Alternative K and A would reflect current opportunities the first decade and then decrease in future decades. Alternatives J, W, L, and D, respectively, would increase opportunities to hunt deer and elk as populations respond to habitat conditions.

Fishing opportunities on the Forest will vary considerably through the alternatives, with both anadromous and resident fish use highest in Alternatives W, D, and L. Alternatives K, A, and J will have the same level of resident fish use, but Alternative J has the highest anadromous fish use of the three and Alternative K the lowest. Anadromous fish use in all alternatives is expected to increase in the second decade and then level off. Resident and anadromous fish use was not estimated for the NC Alternative.

Firewood availability for home heating in the first decade will be lowest in Alternative L. Alternatives K, A, J, and W will have similar firewood opportunities. The most firewood will come from Alternative NC. Firewood availability will remain constant in the second decade except for a slight increase for Alternative D. By the fifth decade firewood availability will decrease by more than 50% for all alternatives except J and W which will have decreases of 27% and 41%, respectively.

Community Cohesion - Community cohesion could be affected by the amount of land available for specific resource uses, especially timber harvest, old growth, undeveloped areas, and pending decisions regarding spotted owl protection. It is expected that polarization (issues which split the community) would increase as alternatives approach the extremes in terms of acres allocated to one or more of these uses. In alternatives that address key resource issues with similar emphasis, it is expected that community cohesion would be present but not in the degree found in the extreme alternatives. However, with the total reduced timber sale/harvest levels in almost all alternatives, as well as related issues such as the continued controversy over the amount of protection for the spotted owl and old growth, it is expected that a high degree of polarization will continue for several years, perhaps until the next planning period. The following discussion addresses those issues expected to most effect the degree of polarization in communities.

Alternatives D and L provide the least amount of acres available for timber harvest activities on the Forest, with Alternative L about two-third of the current level. Alternatives J and W also have fewer acres allocated to timber harvest than in the Current Plan (same as Alternative A), whereas Alternatives NC and K have more acres for timber harvest than the current level.

Old-growth acres will be reduced in all alternatives over time. Alternative L provides the most old growth in all decades, and Alternative D provides the next highest. Alternatives NC, K, A, and J provide a low amount, with Alternative NC having the lowest of all the alternatives. Old growth in Alternatives W and D have more than Alternative A in the first decade, with Alternative D being just above Alternative W by the fifth decade.

Spotted owl habitat will also vary with Alternative L protecting the most owl sites (184), followed by Alternative D (102). Four Alternatives (K, A, J, and W) are at the Management Requirement (MR) level plus some additional owls present in Wilderness. Alternative NC does not protect any owl sites outside of Wilderness or other protected areas; therefore, the NC Alternative provides the least habitat areas of any alternative since MRs are not included.

Alternative L maintains the most (85%) inventoried roadless areas in an undeveloped condition. Alternatives D and W provide somewhat lower amounts but each has more than 50% of the total inventory assigned to unroaded prescriptions. Alternatives A, J, NC, and K maintain less than half of the roadless areas in an undeveloped condition with Alternative K maintaining the least (15%).

Cumulative Effects of the Alternatives on the Social and Economic Setting

The cumulative effects of an alternative on the socioeconomic environment are quite difficult to estimate. One basic problem is that job impact data, especially secondary effects, are dated or nonexistent (1977 base updated to 1982). There is good data on counties and large cities, but for smaller towns the information is incomplete. Another factor is that the severe recession of the early 1980's has fundamentally changed the economy of affected counties and especially the smaller towns and industries. This occurred in spite of the fact that the sale (but not harvest) of Forest timber and recreation opportunities remained constant.

In terms of cumulative effects, Forest timber volumes for sale may have little influence on any one mill, for example an owner can purchase from Bureau of Land Management and private woodlot owners to get additional supply. They can also purchase logs from the Umpqua or Siuslaw National Forests. Or, at the owners choice, they can increase or reduce the size of the mill operation, sell the operation to another company, or simply close the mill. All of these have occurred in the last decade and few, if any, of the changes to companies or communities can be tied directly to the sale of Willamette National Forest timber.

The yearly timber harvest level, rather than the sale level, and production in the mills depends on economic factors outside the control of the Forest. These external factors include, but are not limited to, interest rates, housing starts, marketing of products (including demand for products, bid prices on resources, product pricing, and availability of foreign markets), domestic and foreign competition, international tariffs, and exchange rates. Additional factors that affect companies and individuals that use Forest resources, which employ thousands of people in the primary area of influence, include capital investments (including plant modernization), profits, losses, as well as wages, benefits, and working conditions for employees, structure of the companies/corporations, tax rates and breaks, efficiency of the company operations, and productivity of the workers.

Other timber and recreation suppliers (Bureau of Land Management, Oregon State Forestry, private industry, and woodlot owners) play important roles in the jobs, income, dollar returns, lifestyles, and community cohesion in the affected counties. Cumulative social and economic impacts are most effected by external business decisions rather than most variations shown in the Forest Alternatives.

Mitigation Measures for the Social and Economic Setting

Management of the Forest's natural resources affect many of the people and surrounding communities. Recently disputes over old-growth forests and spotted owl habitat has resulted in the reduce sale of timber and consequent reductions in natural resource payments to counties for road and school budgets. Resource dependent communities are also threatened by changing policies in Congress and Federal land management agencies. In response to growing concern over the economic vitality of communities the Forest Service serves and the pressure and change taking place in natural resource management, Region 6 has recently adopted a proposal designated the "Pacific Northwest Strategy".

The Pacific Northwest Strategy is a regional effort of the Forest Service to form partnerships focused on helping resource-dependent communities prepare for and achieve their desired future. The intent of the Pacific Northwest Strategy is to assist resource-dependent communities in preparing and managing their future by:

- Developing future community leadership,
- Strengthening basic education,
- Establishing a sense of community pride, ownership, and belonging,
- Actively incorporating family, children, and youth,
- Identifying needs and resources,
- Assuming ownership responsibilities to local jurisdictions by all land ownerships.
- Creating partnerships and networks,
- Coordinating among local, State and Federal efforts.

Relationships with Other Agency Plans or Policies for the Social and Economic Setting

Bureau of Land Management (BLM) - Coordination between the BLM and the Forest Service is occurring at the BLM State Office and Forest Service Regional Office regarding planning efforts of both agencies. In addition, coordination occurs between the BLM-Eugene District and BLM-Salem District and the Forest. In terms of socioeconomic effects, the common area of concern between the agencies is the distribution of Federal monies due to the presence of Federal lands in each county. For the Forest, the distribution of Federal monies to the counties depends almost entirely on the timber harvested and the amount of National Forest and O&C Lands in each county.

State Forestry Program for Oregon (FPFO) - The Oregon Department of Forestry (ODF) has developed, in conjunction with the State Board of Forestry, the "Forestry Program for Oregon". At one point, a key to this program for the Forest was the output levels assigned to the various land "owners" (state, private, industrial, and federal) required to accomplish the coordinated programs envisioned.

The volume figure previously given the Forest as an objective, however, is no longer considered an accurate reflection of the objectives for the FPFO or an objective for the Forest to consider in its implementation of the Plan (State Forester letter, March 21, 1990). The target represents data that were collected over a decade ago and that were published based on a situation that existed in January, 1980. The Program has been re-focused on the intent of Oregon's forestry programs rather than on a comparison of numbers. The ODF recognizes that there are legal constraints the Forest must abide by in setting harvest levels.

The objectives of the new FPFO relevant to the Forest Plan and FEIS are:

1. Preserve the forest landbase of Oregon and assure practical forest practices that conserve and protect soil productivity, and air and water quality by:

   - Developing land use recommendations that recognize that forests are dynamic and most forest uses are compatible and that emphasize the integration of forest land uses;

- Encouraging federal agencies to maintain as large and as stable a commercial forest landbase as possible and to minimize future withdrawals from this landbase;

- Recommending that habitat should be managed based upon sound research data and the recognition that forests are dynamic and most forest uses are compatible over time; and

- Cooperatively establishing forest management standards and regulations for the protection of necessary habitat that are based upon the best knowledge available and that are consistent with responsible forest management.

2. Promote the maximum level of sustainable timber growth and harvest on all forest lands available for timber production, consistent with applicable laws and regulations and considering landowner objectives by;

   - Promoting timber growth and harvest on public lands in a manner consistent with the governing statutory direction while seeking to meet Oregon's timber needs through the application of enlightened land and resource management.

   - Supporting the use of intensive timber management practices where professionally, environmentally, and economically sound.

   - Supporting federal policies and initiatives that provide sufficient funding for forest management and timber sale programs on federal land.

3. Encourage appropriate opportunities for other forest uses, such as fish and wildlife habitat, grazing, recreation and scenic values on all forest lands, consistent with landowner objectives by;

   - Encouraging a full range of recreational opportunities on both public and private lands consistent with landowner objectives.

   - Promoting adequate funding for the full implementation, operation and maintenance of forest recreation facilities, including campgrounds, trails, etc., on public forest lands allocated for forest recreation.

4. Devise and use environmentally sound and economically efficient strategies to protect Oregon's forests from wildfire, insects, disease, and other damaging agents by;

   - Encouraging cost-effective federal fire management policies that emphasize planned ignitions over natural ignition fires and that consider impacts to the state's fire protection program.

   - Encouraging that federal plans which develop and implement fire suppression policies be coordinated with the state.

   - Promoting the effective use of integrated pest management as a coordinated approach to pest control actions.

Table IV-10 in the Vegetation section of this Chapter, illustrates how acres are allocated under each alternative to full yield or partial yield.

State of Oregon Land Conservation and Development Commission (LCDC) - The State of Oregon has mandated a county planning program. At this time, the Counties of Lane, Linn, and Marion have completed their LCDC plans. Lane County is currently in the process of revising their plan with respect to the uses of primary and secondary forest land. An Oregon statute requires that the County plans be coordinated with all levels of government (ORS 197.015(5)). In addition, LCDC Goal Number 2 requires that "City, county, state, and federal agency and special district plans and actions related to land use shall be consistent with the comprehensive plans of cities and counties and regional plans." The guidelines for this goal include the following statement: "During the preparation of their plans, federal, state, and regional agencies are expected to create opportunities for review and comment by cities and counties." Review of the primary county plans and proposals for revision has occurred at the Ranger District and Supervisor Office levels on the Forest. In addition, the Forest has consulted with the counties regarding the DEIS and Proposed Forest Plan and has remained in contact with County Commissioners through meetings and periodic mailings of planning newsletters.

The counties in the Forest's primary area of influence are concerned about the economic well-being of their businesses and citizens as well as the overall livability of the area. Objectives associated with these concerns are not always complimentary and result in the need to seek a balance between competing interests at all levels of planning.

Incomplete or Unavailable Information on Communities

Predictions of effects were made with the most current information available. The following topics which effect these predictions require additional information to allow more accurate predictions:

- Future social and economic trends that would influence local communities. For example, the effects of forest timber supplies on local commnities might by amplified or offset by changes in the national and international demand for wood products, advances in mill technology, log export restrictions, and incentives for timber supplies from other land owners. Also, the aesthetic ties between the forest and the communities would be influenced by demographic and economic trends of the local population.

- Future management and resource outputs on lands other than the Forest.

- Community specific information on effects.

- Data on nonlinear relationships between resource outputs and jobs/income.

- Changes in the relationship between forest outputs and jobs and income that have occuryed during the latest national economic cycle.

Environmental Consequences Of The Alternatives On Scenery

The scenic importance of a Forest area is based upon its proximity to travelways and use areas, its relative attractiveness, and the concern users have for scenic quality. Although the degree of visitor sensitivity to the visual environment is difficult to quantify, many people expect to see a naturally appearing landscape in the Forest environment.

All of the alternatives contain activities that change the natural appearance of the Forest by reshaping landforms or altering the vegetative cover of the landscape. Activities associated with timber harvest generally have the most widespread consequence, though road construction, building, and site development also affect scenery. Significant activities introduce line and color changes that contrast with the natural landscape. These physical changes have the potential to dominate a scene and alter its esthetic value.

There are ten viewshed areas in the Forest which are used to display the likely consequences of the proposed alternatives. The effects of the alternatives are estimated by first determining the level of visual quality to be provided, and secondly, by comparing that level of proposed visual quality with the Existing Visual Condition (EVC) of each viewshed.

In the alternatives, each viewshed is allocated to several management areas. Each management area is assigned a Visual Quality Objective (VQO). These VQO descriptions are described in detail in Chapter III, Scenery. The assigned VQOs are designed to manage both long and short term visual effects and range from preservation to maximum modification. Each proposed alternative will vary in its effects based on the amount of area allocated to each management area within specified viewsheds.

The amount and distribution of each VQO, in aggregate, determines the level of proposed visual quality in each viewshed. The aggregate visual quality proposed for each viewshed is compared with its existing visual condition to determine the expected effects of each alternative.

The EVC of each viewshed is expressed in degrees of apparent landscape alteration. EVC categories include naturally appearing, slightly altered, moderately altered, and heavily altered. Effects that each alternative have on viewsheds are expressed as changes from current EVC levels.

Direct and Indirect Effects of the Alternatives on Scenery

The most obvious and significant effects on scenery are from vegetation and landform alterations typically associated with such resource management activities as timber harvest, road construction, recreation facility development, and mineral exploration. These activities have the potential to alter the natural attributes of landform, vegetation patterns and textures; create stark and dramatic contrasts of exposed soil surfaces with surrounding vegetation; and introduce structural features, such as buildings, utility structures, and electronic towers into the natural landscape. The clearcutting and shelterwood methods of tree removal create openings in the Forest canopy resulting in distinct contrasts between exposed soil and the surrounding landscape. These created openings will vary in their effects on scenery depending on their size, shape, location, and proximity to other openings. Created openings that exhibit attributes of scale, edge effect, shape, and location characteristic of natural openings in the surrounding landscape will have more favorable effects on scenery. Openings that are geometric in shape and large in size relative to natural openings in the surrounding landscape will have an adverse effect on scenery.

Road construction also creates linear openings in the Forest canopy. Roads, primarily in mid-slope locations in steep terrain, often result in the exposure of cut and fill slopes and tree boles, creating an unnatural line effect in the landscape that is usually permanent.

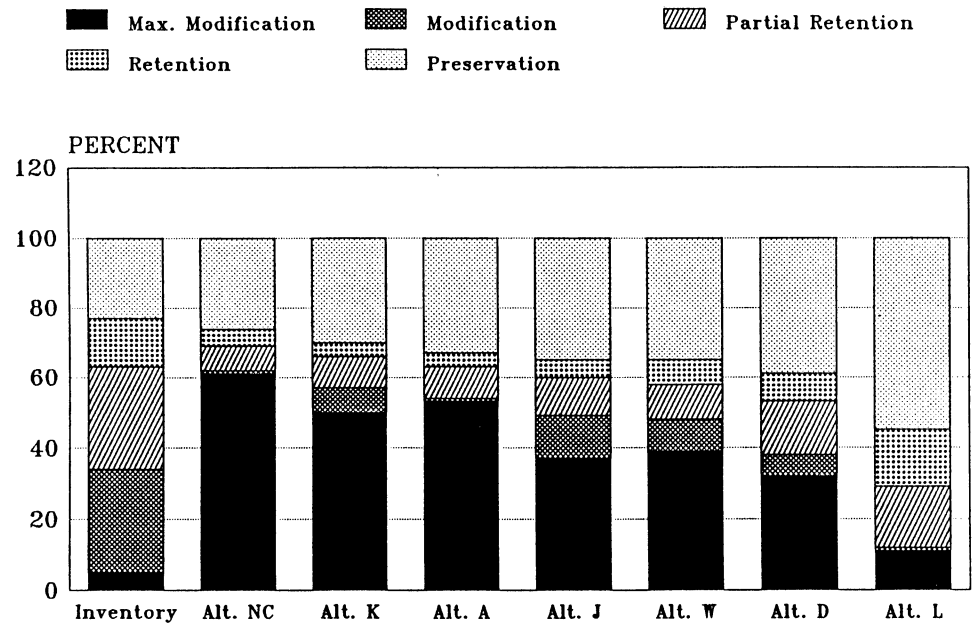
Minerals and energy development activities have the potential to affect scenery to a greater extent than the combined effects of timber harvest and road construction. In addition to tree removal and road construction, minerals or energy development could include significant landform alteration. Effects would also occur from the presence and use of drilling and processing equipment and related facilities. The actual effect of minerals and energy development is unknown however, and can only be determined once a mineral development project is proposed.

The effect of recreation site construction on scenery is minimal except for ski areas. The removal of trees for downhill ski runs, base facilities and structures, and access roads can have the visual effect of several large harvest units. However these effects can be minimized through skillful planning and facility design (USDA Forest Service Agricultural Handbook No. 617, 1984). The visual effects of management activities are most pronounced in landscapes with a homogeneous appearing forest canopy, steep slopes, and light colored soils.

The alternatives have varying effects on scenic quality as a result of the type and distribution of the proposed management areas and their associated activities. In general, alternatives emphasizing the production of market goods provide less Forest area managed for high levels of scenic quality. Areas inventoried as retention and partial retention, which are proposed for management as modification and maximum modification objectives, would change dramatically in appearance. Management activities that result in landform and vegetation alterations would change the scenic quality of these areas from natural appearing to moderately and heavily altered landscapes. The middle ground areas within major viewsheds are the areas most sensitive to this effect, as they are typically inventoried as partial retention.

Table IV-28 provides a Forest-wide comparison of alternatives and their effect on scenery as measured against inventoried VQOs. As illustrated, there would be an increase in the amount of area managed for preservation as a consequence of implementing any of the proposed alternatives. However, lands to be managed for retention, partial retention, and modification VQOs would decrease from inventory levels in all alternatives except Alternative L, in which lands managed for a Retention VQO would increase 2% over inventory levels. The amount of Forest land proposed to be managed as maximum modification in all the alternatives is between 2 and 12 times greater than currently inventoried as maximum modification.

Table IV-28. Forest-wide Effects on Inventoried Visual Quality Objectives



Visual Resource Inventory			Alternatives [1]						
Objectives	**Acres**	**Per-cent**	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Preservation	389,486	23	26	30	33	35	35	39	55
Retention	232,262	14	5	4	4	5	7	8	16
Partial Retention	488,649	29	7	9	9	11	10	15	17
Modification	484,170	29	1	7	1	12	9	6	1
Maximum Modification	80,841	5	61	50	53	37	39	32	11
TOTAL	1,675,408	100	100	100	100	100	100	100	100

[1]Expressed as percent of Inventoried Visual Quality Objective acres.

Alternatives L and D propose management of most viewshed middlegrounds as retention and partial retention while Alternatives NC, K, and A, propose management of most viewshed middlegrounds for modification and maximum modification visual quality. Alternatives J and W (PA) propose management of viewshed middleground areas primarily for modification and partial retention objectives.
Table IV-29 illustrates the changes in visual quality proposed by the alternatives for each viewshed.

Table IV-29. Visual Quality Changes for Viewshed and Nonviewshed Areas

		Alternatives						
Viewshed Acres	Inventory Acres	NC	K	A	J	W	D	L
Little North Santiam								
Preservation	0.0	2.8	3.1	3.2	3.3	3.4	8.8	3.9
Retention	5.7	1.9	0.0	1.9	0.0	2.2	1.3	6.0
Partial Retention	6.1	1.9	0.6	2.1	2.5	0.8	0.5	2.1
Modification	0.3	0.1	2.1	0.1	5.8	3.9	1.2	0.1
Maximum Modification	0.0	5.3	6.3	4.8	0.4	1.8	0.3	0.0
Breitenbush								
Preservation	0.0	0.2	3.7	3.3	3.4	3.6	4.5	9.7
Retention	15.4	0.2	0.1	0.2	3.6	2.9	9.3	9.2
Partial Retention	15.1	3.7	1.6	4.0	3.7	6.1	3.6	13.0
Modification	1.6	0.2	2.1	0.2	16.9	9.3	14.5	0.2
Maximum Modification	0.0	27.8	24.6	24.5	4.5	10.4	0.2	0.2
North Santiam								
Preservation	0.0	0.1	5.2	5.3	5.5	5.5	6.8	12.6
Retention	24.8	7.7	10.8	7.3	9.0	7.7	13.4	23.1
Partial Retention	23.7	4.3	2.0	5.1	8.9	16.6	30.5	6.4
Modification	2.1	0.7	33.2	0.7	28.2	15.3	0.7	0.6
Maximum Modification	1.1	38.8	0.6	33.4	2.0	6.7	0.4	11.3
South Santiam								
Preservation	0.1	5.6	4.8	8.9	15.9	15.9	19.2	23.9
Retention	14.1	5.9	4.6	4.5	5.5	5.5	9.4	5.4
Partial Retention	21.0	0.1	2.9	1.1	3.6	4.06	10.3	4.2
Modification	9.3	.1	28.4	.1	16.2	16.1	4.5	.1
Maximum Modification	0.1	32.9	3.9	30.0	3.4	3.1	1.1	10.9
McKenzie								
Preservation	0.4	1.7	9.9	10.3	19.2	17.8	35.0	45.5
Retention	38.2	27.2	19.1	24.2	20.7	24.0	18.2	31.8
Partial Retention	37.4	30.6	33.5	29.8	29.0	24.7	25.8	27.7
Modification	9.1	0.7	7.1	0.7	6.0	5.4	3.8	0.7
Maximum Modification	6.6	31.4	21.9	26.8	16.6	19.7	8.8	3.9
North Fork/South Fork								
Preservation	0.0	6.2	7.7	13.7	18.3	18.2	14.8	33.1
Retention	34.2	7.0	1.3	6.5	4.8	10.1	10.8	16.7
Partial Retention	29.1	12.7	11.7	14.1	15.4	9.7	24.0	30.6
Modification	14.0	0.1	6.9	0.1	40.0	34.7	28.5	0.1
Maximum Modification	3.2	54.4	52.9	46.2	2.0	7.7	2.4	.0.0
Fall Creek								
Preservation	0.0	0.1	3.9	4.0	7.9	6.8	4.3	14.2
Retention	2.5	5.2	0.0	3.0	0.1	0.4	2.2	6.2
Partial Retention	6.9	0.2	2.1	1.6	5.9	7.4	7.7	10.4
Modification	21.4	0.1	2.0	0.1	16.8	.0.1	16.3	0.1
Maximum Modification	0.0	25.3	22.8	22.1	0.1	16.1	0.2	0.0

Table IV-29 Cont. Visual Quality Changes for Viewshed and Nonviewshed Areas

		Alternatives						
Viewshed Acres	**Inventory Acres**	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Willamette								
Preservation	0.0	2.7	12.6	14.4	18.1	19.4	23.1	48.9
Retention	27.5	19.9	14.9	18.0	15.1	14.5	13.7	27.5
Partial Retention	53.3	13.4	26.7	13.6	23.0	25.0	51.5	11.8
Modification	15.5	2.0	25.7	2.0	35.0	19.9	2.6	2.0
Maximum Modification	0.0	58.3	16.3	48.2	4.9	17.4	5.3	6.8
Waldo								
Preservation	0.5	20.3	1.8	20.3	17.5	16.8	17.5	26.5
Retention	17.7	6.3	4.2	0.0	2.9	9.7	9.0	0.0
Partial Retention	8.4	0.0	20.6	6.4	6.3	0.1	0.1	0.1
Modification	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Maximum Modification	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Middle Fork								
Preservation	0.0	0.2	7.9	7.8	8.5	8.7	12.1	24.7
Retention	0.1	0.0	2.2	0.0	8.9	8.9	14.7	18.5
Partial Retention	25.4	12.4	3.6	14.2	16.3	17.5	12.4	13.1
Modification	35.6	0.1	10.7	0.1	20.6	16.7	25.4	0.1
Maximum Modification	7.1	56.5	44.9	47.0	14.9	17.4	4.6	13.6
Non-Viewshed Areas								
Preservation	388.6	398.2	443.2	456.4	468.8	475.1	501.6	669.8
Retention	52.1	13.5	14.8	12.5	19.8	32.9	40.0	138.7
Partial Retention	261.3	28.5	42.1	58.3	63.0	59.8	79.3	167.1
Modification	375.2	0.4	5.2	0.4	20.6	21.8	10.8	0.4
Maximum Modification	62.8	699.3	634.6	612.4	567.7	550.4	508.2	164.0

The amount of area assigned to each VQO in each viewshed has a major effect on the future visual condition. If the amount of area assigned to preservation, retention, and partial retention VQOs in a viewshed is increased over current amounts, particularly in middleground areas, it is likely that the EVC would be maintained or improved in the viewshed over the long-term. However, if acreages assigned to these VQOs remain the same or decrease from current levels, the scenic quality of a viewshed is expected to become more altered in appearance in the near-future (10-20 years).

The proposed VQO changes of the alternatives, as illustrated in Tables IV-28 and 29, would have the effect of altering the existing visual condition of Forest viewsheds. Based on EVC ratings; the amount of area assigned to each VQO; the distribution of each management area in relation to important travel routes, use areas and sites; and the rate of programmed harvest associated with each management area the expected future visual condition of each viewshed is determined. Table IV-30 summarizes the effect of each alternative on the scenery of each Forest viewshed.

Table IV-30. Expected Changes to Existing Visual Conditions of Forest Viewsheds

Existing Visual Condition			Alternatives						
Viewshed	Acres [1]	EVC Rating [2]	NC	K	A	J	W	D	L
Little North Santiam	12,222	1	3	4	3	3	2	1	1
Breitenbush	32,357	4	4	4	4	4	3	2	2
North Santiam	63,926	3	4	4	4	3	2	1	2
South Santiam	53,006	2	4	4	4	2	2	1	2
McKenzie	103,131	3	3	3	3	2	2	1	1
North Fork/South Fork	81,033	2	4	4	4	3	3	2	1
Fall Creek	30,929	1	4	4	4	2	3	2	1
Willamette	102,747	3	4	3	4	3	3	1	1
Waldo	26,706	1	1	3	1	1	1	1	1
Middle Fork	83,250	3	4	4	4	3	3	2	1

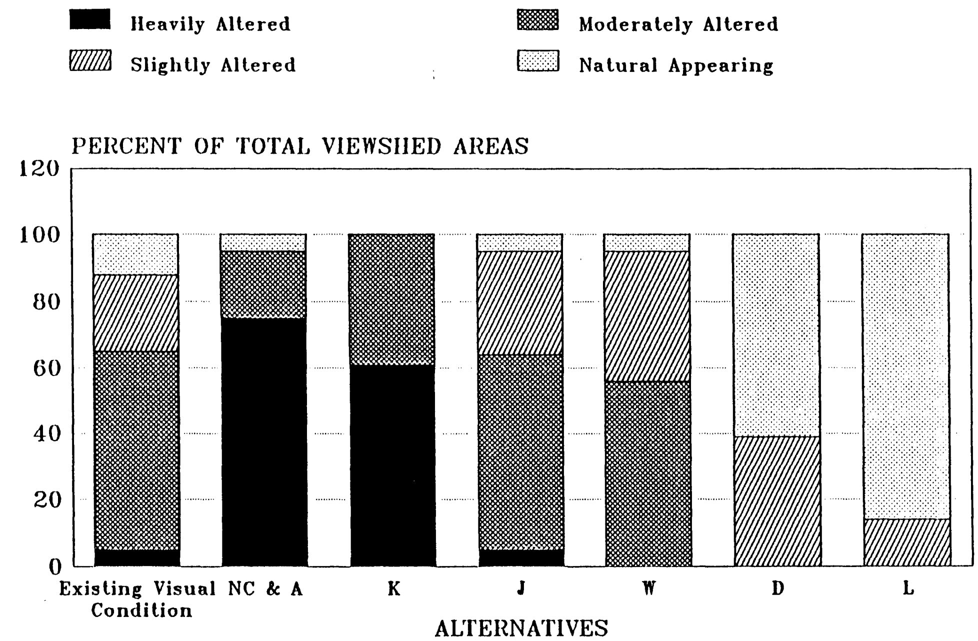
[1] Acreages include non-National Forest land.
[2] 1 = Natural Appearing.
2 = Slightly Altered.
3 = Moderately Altered.
4 = Heavily Altered.

In Alternative D and L the existing visual conditions of all viewsheds would be maintained or improved with one exception. The Fall Creek viewshed would become slightly altered in Alternative D.

Alternative W (PA) maintains or improves the EVC, and hence, the natural appearance of all but two viewsheds. In Alternative W (PA) both the Little North Santiam and the Fall Creek viewsheds would change from natural appearing to slightly altered conditions. Alternative J also maintains or improves conditions of most viewsheds. This Alternative maintains the EVC of six viewsheds and proposes to improve conditons of the McKenzie viewshed. The EVC of the Little North Santiam, Fall Creek and Willamette viewsheds would become altered under this alternative.

In Alternatives NC, K and A, existing visual conditions of Forest viewsheds are expected to diminish. All viewsheds in these alternatives, except one, would remain or become moderately or heavily altered. The Fall Creek viewshed in Alternative NC and A would be maintained in a natural appearing condition. The generalized effect of the alternatives on the Forest's existing visual condition is summarized in Figure IV-17.

Figure IV-17. Expected Changes to Visual Conditions of Forest Viewsheds



Existing Visual Condition			Alternatives [1]						
Condition Class	Acres	Percent	NC	K	A	J	W	D	L
Natural Appearing	69,857	12	5	0	5	5	5	61	86
Slightly Altered	134,039	23	0	0	0	31	39	39	14
Moderately Altered	353,054	60	20	39	20	59	56	0	0
Heavily Altered	32,357	5	75	61	75	5	0	0	0
VIEWSHED TOTALS	589,307	100	100	100	100	100	100	100	100

[1] Alternative values are in percent of total viewshed acres

Cumulative Effects on Scenery

While a single activity may only affect its immediate surroundings, many activities over several years or decades would affect the scenic quality of the Forest as illustrated in Figure IV-17. This effect has even greater consequence in areas where private or other public agency land is adjacent to the Forest. Areas with large blocks of intermingled ownership may display these effects most significantly. It is assumed that private landowners having a large timber inventory will harvest timber and will not maintain the landscape in a natural appearing condition. These areas within and adjacent to National Forest lands will be seen from some travel routes, recreation roads and trails, high vista points, and from aircraft. This "checkerboard" effect will be most apparent in the North Santiam, South Santiam, and Middle Fork of the Willamette drainages and to a lesser extent in the McKenzie drainage and around the community of Oakridge.

Alternatives NC, K and A would have long-term cumulative effects of altering viewsheds at a rapid rate due to the amount of land allocated to general forest and associated harvest levels. The NC Alternative would have a more dramatic effect than K or A on viewshed conditions. This alternative makes available more acres of the general forest in viewshed areas and proposes their harvest at an increased rate. Alternatives J and W (PA) would also result in long-term effects to the appearance of Forest viewsheds. The most significant effect would occur from shifts in EVCs to expected future conditions of some viewsheds. Generally, Alternative J would maintain or improve the existing condition of most viewsheds and lower conditions of a some others. Alternative W (PA) would improve conditions of appearance for four viewsheds, maintain conditions of four, and lower conditions of two others.

Alternatives D and L would have the least cumulative effect on the scenery as these alternatives emphasize the maintenance or improvement of scenic quality within all viewsheds of major travel corridors.

Mitigation Measures for Scenery

The appearance of the landscape will change as management activities are implemented to fulfill Forest Plan objectives. Several published visual resource handbook guides, such as "National Forest Landscape Management, Volumes 1 and 2", specify mitigation methods for scenery, many of which are included in the standards and guidelines of the Forest Plan.

In scenic viewshed corridors, timber harvest areas will be shaped to blend with the terrain to minimize contrast with the character of the existing landscape. Roads will be seeded along steep cutbanks and screened by vegetation. Along critical roads, trails, streams, lakes, and dispersed sites timber harvest units may be restricted in size. In selected management areas, the latitude of vegetative management activities is restricted. For example, harvest levels may be reduced, or complex logging systems and/or stringent cleanup procedures may be required to achieve scenic objectives.

Recreational settings in particular are managed with visual objectives that reflect the concerns of recreational users and expected levels of recreation use. Dispersed camping areas are to be set back from lakes, streams, trails and key interest features to disperse the effects of recreational activity. Developed sites have the potential to contrast dramatically with their surroundings; these potential contrasts are partially mitigated through the use of professional site planning and landscape design skills as well as through the use of native or natural appearing materials and use of "earth tone color" paints and stains. Vegetative screens and/or dispersed or buried facilities may provide adequate mitigation, though in some cases, visual constraints could eliminate certain types of developed site construction.

Relationships With Other Agency Plans or Policies for Scenery

In some viewsheds there may be differences between the Forest Service objectives and those of adjacent landowners or other land management agencies, such as the State of Oregon and Bureau of Land Management. The Forest coordinates with a number of other agencies to ensure that visual resource quality is maintained along state and federal highways, around reservoirs, and around utility lines and electronics sites. To identify potential conflicts and further coordination between other agencies and the Forest Service, a number of operation and maintenance plans are reviewed, including those of the Army Corps of Engineers, Eugene Water and Electric Board, Bonneville Power Administration, the State Department of Transportation, and the Oregon Department of Fish and Wildlife. County zoning actions and adjustments would also be reviewed during project planning.

Incomplete and Unavailable Information

Inventories used in scenic resource management are in need of updating to incorporate the most recent research on human perception and scenic quality expectations of Forest visitors.

Digital terrain data of the Forest landscape is needed for use in visual simulations of proposed landscape altering activities.

Environmental Consequences Of The Alternatives On Wild And Scenic Rivers

The Wild and Scenic Rivers Act of 1968 (Public Law 90-542 as amended) established a method for providing federal protection for certian of our remaining free-flowing rivers, and preserving them and their immediate environments for the use and enjoyment of present and future generations. Rivers are included in the system so that they may benifit from protective management and control of development for which the Act provides.

Numerous river corridors in the Forest draw increasing numbers of users annually because of their special attributes and some have gained both State-wide and National attention. At this time there are 2 designated National Wild and Scenic Rivers, 2 designated Wild and Scenic Study Rivers, and 4 designated State Scenic Waterways within the Forest. The McKenzie River and the North Fork of the Middle Fork of the Willamette River are designated as included in the National System and Blue River and the South Fork of the McKenzie are designated as Study Rivers. Rivers designated as State Scenic Waterways include: Little North Santiam; McKenzie, South Fork of the McKenzie; and North Fork of the Middle Fork of the Willamette Rivers. In addition, all or portions of 8 rivers on the Forest have been determined eligible for Wild and Scenic River status. Table IV-31 displays the designation status of Forest rivers. A discussion of each river listed in Table IV-31 is included in Appendix E together with a tabular listing of river mileage, corridor acres, "outstandingly remarkable" values and potential river classification.

Direct and Indirect Effects of the Alternatives on Wild and Scenic Rivers

The setting of a wild and scenic river provides for a wide range of recreational opportunities which are enhanced by the river's free-flowing condition and "outstandingly remarkable" values and the quality of its surrounding environment. Activities that could affect river values include timber harvest, road and bridge construction, prospecting and mineral extraction, geothermal development, expansion of hydroelectric generating facilities, and development of private land in the area. Environmental changes in river corridors resulting frome these activities could limit a rivers future consideration for inclusion into the National Wild and Scenic Rivers system.

The location and extent of the effects of the alternatives on eligible and designated study river values is relative to the particular management area(s) applied to river corridors. Management areas that emphasize timber harvest, provide for road construction, permit mineral extraction, and allow for hydroelectric or geothermal development have a high probability of altering potential WSR values. Management areas that limit road development, timber harvest rates, and adjust harvest unit designs commensurate with a high level of scenic quality (retention VQO), will typically maintain resource values of river corridors consistent with Scenic or Recreation river classifications. Management areas that prohibit timber harvest and all development, except for low impact recreational facilities, are expected to preserve potential WSR environments in their current condition.

Table IV-31. Designation Status of Forest Rivers[1]

River Name	National WSR	State Scenic Waterway	National WSR Study River	Eligible Rivers
Little North Santiam River		X		X
South Fork Breitenbush River				X
Breitenbush River				X
North Santiam River				X
Quartzville Creek				X
Middle Santiam River				X
South Santiam River				X
McKenzie River	X	X		
Blue River			X	
South Fork McKenzie River		X	X	
NF of the MF Willamette River	X	X		
Middle Fork Willamette River				X

[1]See also Appendix E for a disscussion of each river and a display of corridor acreage, river mileage, river values, and potential classification.

Although none of the alternatives recommend that Congress designate additional Forest rivers as included into the National Wild and Scenic Rivers system, all alternatives, execpt the NC Alternative, specify measures to preserve free-flowing conditions, and protect "outstandingly remarkable" scenic, recreational, geologic, fish, wildlife, historical/cultural, biological and ecological values of all designated, study and eligible rivers. Protection of these rivers and their associated values is extended until a river is determined un-suitable for inclusion into the National System.

Through interim protection of these river values potential WSR corridors would be managed to provide opportunities for a broad range of river oriented recreation activities, such as boating, rafting, fishing, hiking and camping. Other activities, including road construction or timber harvest, would be permitted with these corridors providing that such activities would not lower a rivers potential WSR classification or affect it's eligibility for inclusion into the National System.

Alternative NC is the only alternative that fails to protect the free-flowing conditions and the "outstandingly remarkable" values of eligible rivers in the Forest from development activities. Eligible rivers in this alternative are protected to the extent that scenic management areas overlay these potential WSR corridors as well as through the application of riparian management standards. Protection from road construction, mineral extraction or hydroelectric development consistent with potential WSR classifications is not, however afforded in this alternative. This alternative does however provide protection of designated WSRs and study rivers in accord with the requirements of the Wild and Scenic Rivers Act. Table IV-32 provides a summary of the amount and extent of designated, study and eligible rivers corridors to be protected in each alternative.

Table IV-32 Wild and Scenic River Protection Status

		Alternatives						
River Designation[1]	Units	NC	K	A	J	W	D	L
Wild and Scenic Rivers	Rivers	2	2	2	2	2	2	2
	Miles	55.0	55.0	55.0	55.0	55.0	55.0	55.0
	Acres	17,459	17,459	17,459	17,459	17,459	17,459	17,459
W & S Study Rivers	Rivers	2	2	2	2	2	2	2
	Miles	34.2	34.2	34.2	34.2	34.2	34.2	34.2
	Acres	10,944	10,944	10,944	10,944	10,944	10,944	10,944
Eligible for W & S Status	Rivers	0	8	8	8	8	8	8
	Miles	0	122.2	122.2	122.2	122.2	122.2	122.2
	Acres	0	41,927	41,927	41,927	41,927	41,927	41,927
TOTALS	Rivers	4	12	12	12	12	12	12
	Miles	89.2	211.4	211.4	211.4	211.4	211.4	211.4
	Acres	28,403	70,330	70,330	70,330	70,330	70,330	70,330

[1] The Little North Santiam River, McKenzie River, South Fork of the McKenzie River, and the North Fork of the Middle Fork of the Willamette River are also designated as State Scenic Waterways.

In all alternatives, however to a lesser extent in NC the all river corridors will retain the appearance of an old-growth forest through the limiting the size of created openings, extending harvest rotation lengths, and use of uneven-aged havest systems when vegetation management activities are undretaken.

Campsites within these river corridors would remain accessible from existing public roads and other improvements with these corridors, such as signing and parking areas, when planned would be designed to enhance user experience and protect resources in accordance with the requirements of the Wild and Scenic River Act. Construction of dams and development of a river's hydroelectric potential would not be permitted in any alternative, except the NC Alternative. This protection would be extended until a river has been determined unsitable for WSR status.

Cumulative Effects on Wild and Scenic Rivers

As natural settings are altered, the capacity of the Forest to provide wild and scenic river settings would be diminished. Although demand for recreation river experiences may increase, opportunities to protect river values consistent with Wild and Scenic River classification will be forgone or limited.

Mitigation Measures for Wild and Scenic Rivers

The designation of eligible or study rivers as included into the National Wild and Scenic Rivers System has the potential to increase levels of recreation use and subsequent effects on river environments. Historical data from the Rogue Wild and Scenic River display this trend (RIM, Rogue River National Forest, 1970-1985). To prevent degradation of resources and maintain the quality of recreation experiences, standards and guidelines provide for the establishment of carrying capacities for managing use levels and mitigating effects. The effects of crowding on campsites and trail systems can be reduced by substituting facilities and dispersing recreation use. Access to river corridors, provided by the construction and maintenance of signs and trails, will govern the location and degree of effects to these areas from public use.

Some management practices can be employed to ensure that effects of vegetation manipulation remains subordinate to the general scene of the area. These practices include: adjustments in the size and location of timber harvest units and created openings; the regulation of harvest rates; the use of uneven-aged management practices, such as group selection or individual tree selection; handpiling and burning of harvest debris; immediate reforestation of disturbed sites; and locating roads to be visually inconspicuous from the river surface and riverbanks.

Relationships with Other Agency Plans or Policies for Wild and Scenic Rivers

Designation of eligible or study rivers as included into the National Wild and Scenic Rivers system could affect private land use and development. Effects would include compliance with county zoning regulations as well as stipulations of scenic easements. Stipulation may limit vegetation management practices, and establish requirements regarding maintenance and development of private lands. Geothermal resource use and development on private land could be subject to additional constraints similar to those constraining geothermal development on public land.

The current objectives of the Oregon State Scenic Waterways System are not in conflict with the effects of any of the proposed Alternatives. Four rivers in the Forest, the Little North Fork of the North Santiam, the McKenzie, the South Fork of the McKenzie, and the North Fork of the Middle Fork of the Willamette River and Waldo Lake are included in the Oregon State Scenic Waterways System. Their important features of these rivers, such as, water purity, natural trout populations, and plant and animal diversity will continue to be protected through the application of standards and guidelines specified in the Forest Plan. Continuing coordination with the Oregon State Parks Division and the Oregon State Marine Board will be conducted to assure compliance with State regulations for access, use and management of designated rivers. In addition, cooperative efforts will continue with these agencies of the State as participants in suitability studies of eligible and designated study rivers and in the development of river management plans for designated Wild and Scenic Rivers on the Forest.

Inadequate Information

All essential information was available for assessing WSR eligibility of Forest rivers.

Environmental Consequences Of The Alternatives On Roadless Lands

Roadless lands are defined as inventoried areas of undeveloped Federal land within which there are no improved roads maintained for travel by motorized vehicles intended for highway use. The roadless area inventory does not include the Oregon Cascades Recreation Area (OCRA), established Wilderness, or areas non-contiguous to Wilderness that are less than 5,000 acres in size. Due to these existing areas, there will always be, as a minimum, 23% of the Forest in a roadless condition.

The Forest, prior to release of the DEIS, and following passage of the Oregon Wilderness Act of 1984, had 31 inventoried roadless areas that totaled 210,207 acres. During the period 1984-1987 and the period following release of the DEIS (1987-1989), management activities were being implemented in many of these areas. A recent assessment of inventoried roadless area conditions indicates that 38,200 acres have been affected by management activities since the 1984 inventory was completed. The roadless area inventory currently includes 31 areas that total 172,007 acres in parcels that are at least 5,000 acres in size, except where contiguous to established Wilderness, smaller areas are included. The disposition of these lands has become an important public issue.

In the current planning cycle, these roadless lands are available for a range of multiple resource uses including those of timber production, fish and wildlife habitat, research, recreation, and in one instance Wilderness. The timber on roadless lands has a commodity value and has the potential to contribute to both the economic and social pattern of local communities. Roadless lands also have the potential to provide settings for recreation, and opportunities to interweave the physical environment with particular social factors such as isolation, remoteness, and personal challenge.

An important consequence of the alternatives is whether or not these lands will remain in an unroaded condition, and whether they will meet the minimum requirements for future Wilderness consideration by Congress. Allocation of roadless areas to some uses requires development. These uses include timber harvest, road construction, and special uses such as expansion of existing ski areas and mining exploration. Development activities may affect how people perceive environmental qualities such as naturalness and isolation.

Roadless land is also proposed for some uses which require only partial development. These would include areas allocated to retention and partial retention visual quality objectives, and semiprimitive motorized and nonmotorized recreation areas that permit timber harvest. In these areas, there will be a slower rate of change, and effects will be managed to shorten the time of recovery to natural appearing conditions. In some cases, roadless conditions can also be re-created by limiting the kind of management activities allowed in an area and letting it revert, in time, to a condition where roads and other past alterations are apparent.

Direct and Indirect Effects of the Alternatives on Roadless Lands

As a consequence of implementing any of the proposed alternatives, there would be effects to roadless lands in the Forest. In all alternatives some roadless areas would become developed through road construction, timber harvest, recreation facility development, or mineral exploration and development, while other areas would remain in an undeveloped condition. The extent of development or maintenance of an undeveloped condition of roadless lands is determined by the type of use to which areas are allocated.

Alternatives that favor development of most roadless areas (Alternatives NC, K, A, J, and W (PA)) would diminish the Forest's capacity to satisfy future demand for uses dependent on roadless conditions.

In addition, the option to evaluate roadless lands for Wilderness in the next cycle of Forest planning would be limited. The allocation of roadless lands to development activities typically results in alteration of the landscape, vegetation patterns, and size and shape of individual areas. Changes of this nature limit the potential of an area to provide isolation, solitude, and primitive recreation experiences and hence its suitability for future Wilderness evaluation.

Although development of roadless areas would preclude future Wilderness evaluation and other recreation uses, it would provide for other values and benefits. Development of roadless areas would support maintenance of historic harvest levels, employment of wood products workers, and community stability. In addition, development activities would provide increased forage for big-game animals and habitat for other species.

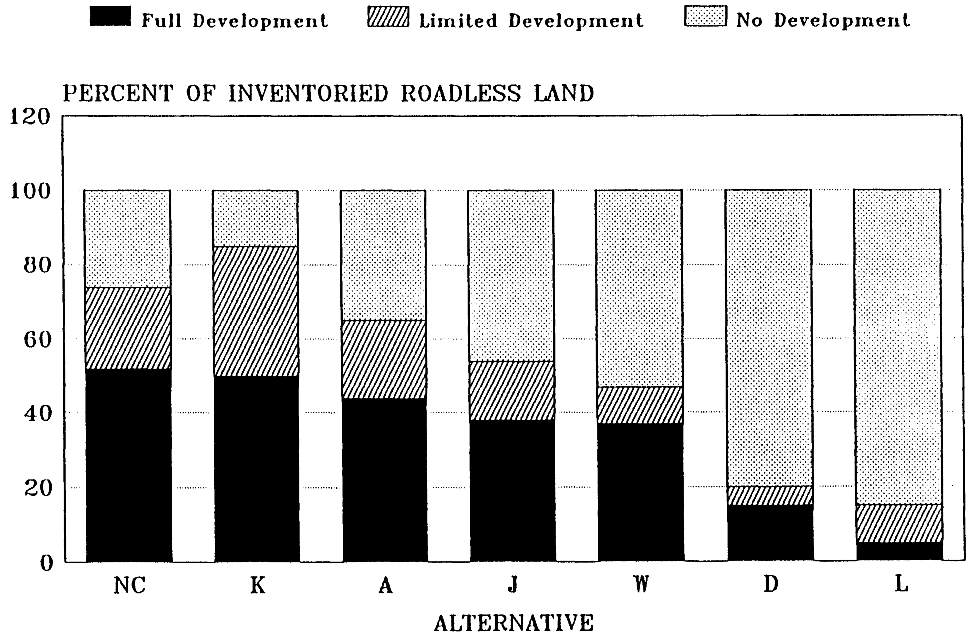
In alternatives that maintain significant portions of most roadless areas (Alternatives D and L), it is likely that greater amounts of future demand for uses dependent on roadless conditions such as semiprimitive recreation could be satisfied. In these alternatives, and to a lesser extent in Alternatives J and W (PA) the Wilderness evaluation option would be retained for many areas for the next cycle of Forest planning. Opportunities for isolation, solitude, and primitive recreation would be maintained in some inventoried roadless areas.

The allocation of roadless areas to uses that do not permit the extraction or removal of priced commodities, such as wood products and minerals, can affect the economic base and social patterns of dependent communities. Employment levels of wood products workers would likely be affected. However, habitats for some wildlife species would be favored, such as species utilizing mature and old-growth timber habitat.

The location and magnitude of these effects are relative to the amount of total roadless land allocated to full development, limited development or no development. As indicated by Table IV-33, Alternatives D and L would maintain between 80 and 85% of all inventoried roadless land respectively in an undeveloped condition while Alternative K maintains 15%. Alternatives NC, A, J, and W (PA) would maintain between 26% and 53% of the Forests roadless land in an undeveloped condition.

As indicated in Table IV-33, Alternative L is the only alternative that recommends the inclusion of roadless land in the National Wilderness Preservation System; Alternative L proposes the study and designation of 169,360 acres of roadless land, including the 6,292 acre Mt. Hagan area, as Wilderness.

Table IV-33. Effects on Roadless Lands [1]



	Alternatives [1]						
Effect Categories	**NC [2]**	**K**	**A**	**J**	**W**	**D**	**L**
Full Development	52	50	44	38	37	15	5
Limited Development	22	35	21	16	10	5	10
No Development	26	15	35	46	53	80	85
TOTAL	100	100	100	100	100	100	100

[1] Values are percent of inventoried roadless land
[2] Includes 6,292 acres of proposed Wilderness.

Table IV-34 displays, by alternative, the amount of each roadless area that would be allocated to an undeveloped condition over the long term. Refer to Appendix C for a detailed description of the development effects of the alternatives on each roadless area.

Table IV-34. Percent of Roadless Land Retained in an Undeveloped Condition

	Alternatives							
Roadless Area	**Acres**	**NC [1]**	**K**	**A**	**J**	**W**	**D**	**L**
Bull of the Woods	6,375	65	76	75	95	94	94	56
Opal Creek	10,687	3	10	11	10	16	44	78
Elkhorn	8,958	0	15	15	15	20	99	39
Mt. Jefferson North	6,036	1	15	11	15	18	75	78
Mt. Jefferson South	4,991	1	36	28	33	34	80	98
Middle Santiam	6,783	0	3	3	3	7	59	91
Echo Mountain	7,551	68	7	70	84	81	98	99
Moose Lake	4,778	0	25	25	25	28	27	69
Menagerie (Rooster Rock)	405	0	0	0	0	5	0	16
Gordon Meadows	8,361	0	5	2	32	44	96	94
Mt. Washington North	1,003	2	15	2	21	21	100	96
Mt. Washington West	6,676	1	2	3	12	15	97	49
Mt. Washington South	4,224	3	6	3	89	90	100	100
Huckleberry	853	100	93	100	100	100	100	100
Frog Camp	469	100	0	0	100	100	100	100
Gold Creek	1,045	2	16	16	29	33	78	98
Rainbow Falls	43	0	0	0	0	0	0	0
Mosquito Creek	406	5	0	5	0	11	0	74
French Pete [1]	2,581	1	9	13	72	79	98	36
Roaring River	2,048	0	0	0	10	9	9	82
Mt. Hagan [2]	6,292	12	21	33	39	42	99	75
McLennen Mountain	7,807	8	21	21	21	23	49	83
Chucksney Mountain	15,507	59	9	66	68	70	83	89
Waldo Lake [1]	31,889	31	6	35	50	72	88	96
Cornpatch	6,762	0	22	22	22	46	26	90
Charlton Butte	2,880	100	41	100	100	100	100	100
Maiden Peak	11,070	100	8	100	100	100	100	100
Hardesty Mountain	3,690	1	27	27	66	71	83	99
Bulldog Rock	555	50	27	50	100	100	100	100
Diamond Peak North	1,130	2	19	17	40	58	81	96
Diamond Peak South	149	0	0	0	0	100	100	71
Total All Areas-Acres and %	172,007	26	15	35	46	53	80	85

[1]This area is divided into several parts for purposes of description in Appendix C.
[2]The Mt. Hagan area is recommended for Wildernes in Alternative L.

Cumulative Effects on Roadless Lands

The cumulative effect on roadless lands is relative to the extent of their development in the alternatives from both the activities on the Forest and those of adjacent land owners. Each alternative proposes different levels of development for different amounts of the inventoried roadless areas. The proposed development of areas, whether full or limited would alter the roadless condition of each area gradually through time. As roads are constructed and timber sale units are harvested, roadless areas would be altered in size and shape. In addition roadless areas adjacent to other land ownerships are subject to the external influences of their management. These effects would alter the potential of individual areas to provide wilderness quality experiences and opportunities in the future.

Areas of 5,000 acres or larger, maintained in an undeveloped condition, would be available for consideration as Wilderness in the next cycle of land management planning. Roadless lands that are allocated to limited development uses would be developed 30-50% slower than areas to be fully developed. This slower rate of development could maintain the current roadless condition of some areas depending on: access strategies, such as helicopter or other aerial harvest systems; project location and design; and implementation schedules. Areas included in the full development category are not expected to remain roadless much beyond 2010.

Mitigation Measures for Roadless Lands

On roadless land proposed for limited development, there will be a slower rate of change than on intensively managed lands, and impacts can be managed to shorten the time of recovery to natural conditions. Where roadless lands have been allocated to scenic uses, timber harvest is reduced to 5-7% of the area per decade. Cutting units will be designed to reflect the vegetative patterns of the characteristic landscape. Three major methods of mitigating effects to roadless lands are: the allocation lands to non-development uses; the use of aerial harvest systems without the construction of roads; and a general development strategy that limits harvest access and activities to the perimeter of individual areas where feasible.

Relationship With Other Agency Plans or Policies for Roadless Lands

There are no conflicts with the proposed allocation of roadless lands in the alternatives with the plans or policies of other agencies.

Incomplete or Unavailable Information

Detailed location and extent of scheduled road construction and timber harvest for the period 1991 through 2000.

Environmental Consequences Of The Alternatives On Wilderness

The environmental qualities of naturalness and solitude will continue to characterize designated Wilderness, although as a consequence of implementing any of the proposed alternatives there will be change, within acceptable levels, in some aspects of Wilderness settings. Wilderness will continue to provide a range of recreation opportunities that interweave the physical and biological features of water, air, soil, geology, vegetation, fish and wildlife with particular social factors such as isolation, remoteness and personal challenge.

The Wilderness Act of 1964 states that Wilderness is to be managed in such a manner "devoted to the public purposes of recreational, scenic, scientific, educational, conservation and historical use" only to the extent that the essential wilderness character of the area is protected. Managers are faced, therefore, with the problem of accommodating human use yet preserving an area's wilderness quality.

Given that any use of the environment produces at least some impact, managers must identify where, and to what extent, varying degrees of change are appropriate and acceptable within wilderness settings. This is accomplished through the use of the Wilderness Resource Spectrum (WRS) system. Wilderness settings are characterized within the WRS as Pristine, Primitive, Semiprimitive and Transition classes. For a description of WRS classes refer to Chapter III, Wilderness.

Changes in WRS classifications result primarily from resource conditions affected by the amount and type of user activities and the inside of designated Wilderness. Although activities, such as timber harvest, can cause localized effects near wilderness boundaries, the most significant effects on wilderness settings are relative to access and the amount and type of recreation use that a particular area receives.

Roads provide access to wilderness settings, and trails facilitate and organize recreation use within designated Wilderness. Trails allow people to take advantage of primitive and un-confined types of recreation opportunities. An extensive trail system can result in fewer contacts between users but could cause increased effects to physical and biological aspects of the environment. Increased access can also cause overuse of desirable campsites and attractions. For example, pack and saddle users need water and meadow areas for maintaining their stock, and tend to utilize large campsites. Commercial outfitters and guides may introduce large groups to some wilderness settings, affecting the solitude and isolation of individuals or smaller groups of users.

Each Wilderness within the Forest displays a range of WRS conditions. For example, at major entry points to wilderness, such as Obsidian Trailhead in the Three Sisters Wilderness, use levels are relatively high, with frequent contact between parties. Areas of Wilderness, such as Obsidian Trailhead, would be classified in the Transition WRS class and resource effects would be moderately evident. Elsewhere, within Forest Wildernesses there are places where few people visit and natural conditions remain undisturbed. The Pristine WRS classification would apply to these undisturbed areas. Between these opposing ends of the WRS are the Primitive and Semiprimitive classes, which apply to the intermediate conditions of use and resource quality of wilderness.

Direct and Indirect Effects of the Alternatives on Wilderness

Three factors that vary by alternative with respect to their consequences on Wilderness are: the recommendation of adding acreage to the Wilderness Preservation System; the establishment of WRS management classes and their subsequent projected recreation use; and increased access through road construction and harvest activities along Wilderness boundaries.

Of the proposed alternatives, only Alternative L, recommends lands for Wilderness designation or study. This alternative proposes 169,360 acres of roadless land, including the Mt. Hagan roadless area for study or inclusion in to the National System. This would result in a total of 550,200 acres of Wilderness in this alternative. Congressional legislation would be needed to establish the areas in this alternative as designated Wilderness. A considerable investment of time and money expended on a research project in the Mt. Hagan area would be forgone if the area were designated as Wilderness. In 1981 research personnel began collecting pre-treatment data on channel conditions, vegetation, stream ecosystem, and soil. This pre-treatment data is valuable in establishing a baseline from which to evaluate later treatments. The location of the project is in an undisturbed low elevation drainage near the proposed Hagan Block RNA. The RNA would serve as a control for the treatment area. Undisturbed low elevation areas such as this are not common and this research project would contribute to knowledge of cumulative effects of riparian management.

Designation of WRS classes within each Wilderness allows for management of Wilderness settings for differing experiences and recreation use capacities. The capacity appropriate to each setting is measured by "persons at one time." The capacity to provide for Wilderness use is determined by the amount and distribution of each WRS Class included in each alternative. All of the proposed alternatives provide for Wilderness recreation use within their respective WRS capacities except Alternative NC. Alternative NC does not employ the WRS as a management system. Table IV-35 illustrates the amount of each WRS Class and respective RVD output for the period 1991-2000 provided in each alternative.

Table IV-35. Effects on Wilderness Resource Spectrum Acres and Visitor Days

		Alternatives						
WROS Class	Units	NC [1]	K	A	J	W	D	L
Primitive Trailed-A	MAcres	--	299.3	299.3	299.3	299.7	299.3	411.2
	MRVDs	--	16.7	16.7	16.7	16.7	16.7	16.7
Primitive Trailed-B	MAcres	--	41.0	41.0	41.4	44.0	67.0	54.9
	MRVDs	--	131.0	131.0	131.0	123.4	131.0	131.0
Semiprimitive	MAcres	--	26.0	26.0	36.7	35.0	14.5	81.8
	MRVDs	--	138.4	138.4	195.7	155.9	59.5	199.8
Transition	MAcres	--	14.5	14.5	3.3	2.1	0.0	2.3
	MRVDs	--	66.0	66.0	24.6	22.1	0.0	23.0
TOTAL	MAcres	380.8	380.8	380.8	380.8	380.8	380.8	550.2
	MRVDs	330.7	352.1	352.1	368.0	318.1	207.2	370.5

[1] Wilderness Resource Spectrum Classes are not applicableto the No Change Alternative.

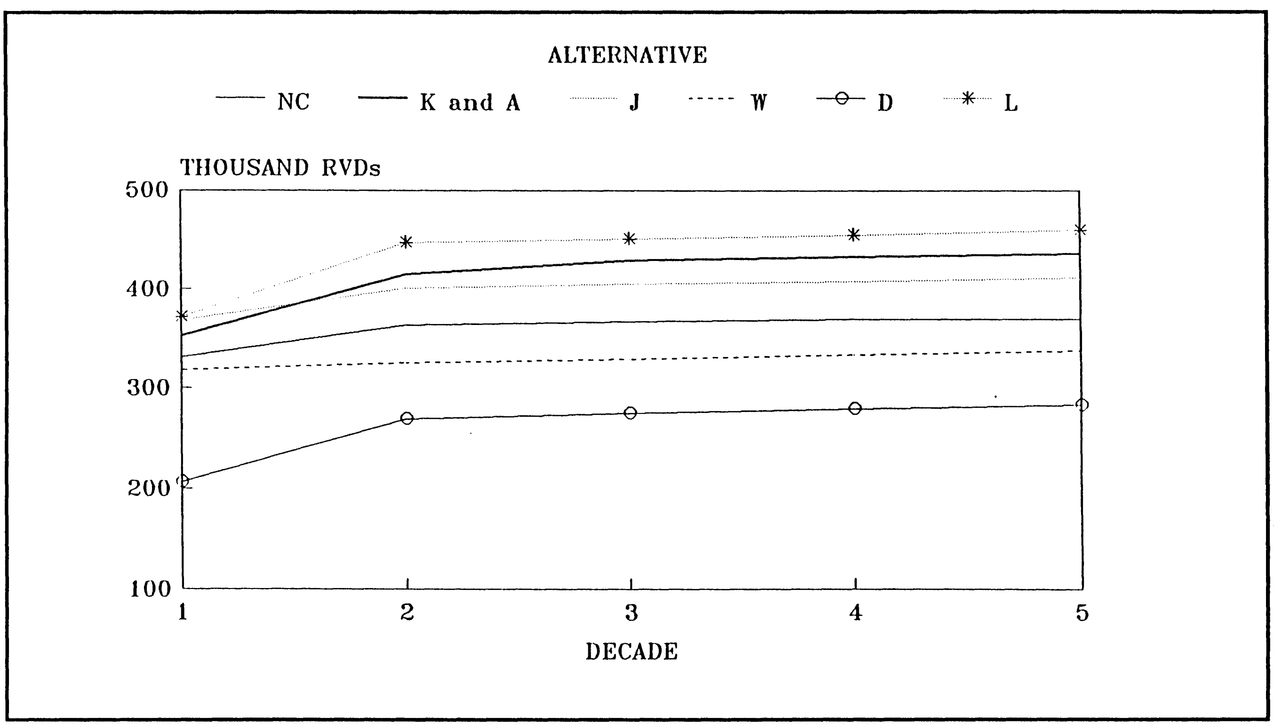
As illustrated in Table IV-35, Alternatives D and L will provide the highest quality Wilderness experiences; Alternative D by virtue of re-allocating inventoried Semiprimitive Class areas to the Primitive Class and the Transition Class areas to the Semiprimitive Class, thus reducing use levels of Wilderness; and Alternative L through the proposed designation of additional Wilderness. In Alternatives K and A WRS Classes are maintained as currently inventoried. In Alternative J management of interior WRS Classes of each Wilderness is re-allocated from Transition to the Semiprimitive Class. In Alternative W(PA), WRS Classes are also adjusted to improve the quality of Wilderness experience to be provided and to enhance the conditions of wilderness resources. In the NC Alternative wilderness use opportunities are un-differentiated by WRS Class.

Each alternative, except the No Change Alternative, provides for a range of Wilderness use opportunities through the distribution of WRS Classes. Total Wilderness use varies among the alternatives over a five decade planning horizon based on the distribution of these WRS classes. Figute IV-18 illustrates the amount of expected Wilderness use by decade for each alternative.

Although Alternatives W, D, and L provide the highest quality Wilderness experience opportunities, they also provide the least amount of use during the planning horizon. These alternatives, through variation in the distribution of WRS acres, propose to alter use levels in Wilderness areas where use has been typically high and where resource conditons fail to comply with limits of acceptable change (LAC). Likely consequences of these alternatives include the displacement of former Wilderness users into nonwilderness areas. The recovery of natural processes and conditions is also expected in areas where heavy use has compacted soil, trampled vegetation, and altered surface runoff patterns.

Alternative J also provides for higher quality opportunities over current conditions through variation of WRS Class acres and with use limitation in some WRS Classes to lower over-all Wilderness use levels. Alternatives K and A, however, maintain current inventory acres for each WRS Class and provide for the same levels of expected future use. These alternatives would not provide for recovery of Wilderness resource conditions in areas where over-use has affected Wilderness values.

Figure IV-18. Effects on Wilderness Use by Decade



The response of the alternatives to user demand (905 MRVDs) in the fifth decade of the planning horizon varies directly in relation to how WRS acres are distributed within Wilderness in each alternative. The alternatives provide for projected future use of Wilderness as follows: Alternative NC, 41%; K, 48%, A,48%, J,46%; W, 37%; D, 31%; and L, 51%.

No new trail construction is proposed in any of the alternatives. Trail construction activities would alter vegetation along the trail corridor, disturb soil surfaces, and change water runoff patterns along steep slopes, and although localized in effect, would lower the WRS Classification of the area within which it occurs.

Effects on nonwilderness trails have potential consequences for Wilderness. Alternatives that emphasize timber harvest, and propose development of most roadless areas, will affect nonwilderness trail opportunities, displacing current users into substitute areas. Expected consequences to Wilderness include: an increase in demand for trail related use; a need to perform trail maintenance or reconstruction more frequently; and a need to regulate user access to Wilderness to assure maintenance of use and resource conditions consistent with the Wilderness Act and Wilderness management area S & Gs. Alternatives NC, K, A, and J are expected to have the greatest effect on Wilderness as they retain the least amount of roadless land and Alternatives W, D, and L have the least as they maintain more roadless land or expand Wilderness use opportunities.

Other activities, external to Wilderness, that have potential to effect the Wilderness environment, its integrity, and its use, include road construction and timber harvest. Road construction and timber harvest can have a dramatic effect on both the amount and character of Wilderness use. Locating roads and harvest units along or in near proximity to the Wilderness boundary can increase the number of possible entry points, result in user developed trail systems, and increase access to areas of high public interest and use. In addition, harvest areas can alter the wind firmness of adjacent Wilderness timber stands, and may reduce scenic quality experiences of adjacent areas as viewed from within Wilderness. Alternatives that emphasize timber harvest, such as NC, K, A and J are expected to have the greatest incidence of these effects, while W, D and L will have fewer.

Cumulative Effects on Wilderness

There are cumulative effects on Wilderness as a consequence of any of the proposed alternatives. One such effect is the designation or nondesignation of lands as Wilderness by Congress. Approximately 22% of the Forest is currently designated Wilderness. This has the effect of preserving a wide range of natural resources in their natural condition. In Wilderness, water, vegetation, soil and air quality will be maintained in a natural state. The non-designation of suitable lands may result in the development of such land and over time may become unsuitable for future Wilderness consideration. Another effect on Wilderness is the development, such as timber harvest and road construction, that may occur adjacent to Wilderness boundaries. This effect will result in physical changes that over a period of time can influence the type or quality of experience opportunities to be provided in Wilderness and alter the microsite conditions along Wilderness boundaries. Typically, without some form of use limitation, improved access could result in a greater number of visitors entering the Wilderness at more locations, adversely affecting the type of user experience currently being provided or intended. In addition continued Wilderness use at current levels could result in the permanent loss of essential Wilderness character in some locations of individual Wildernesses.

Mitigation Measures for Wilderness

Wilderness settings will be managed in all alternatives except NC through the application of standards and guidelines which apply to all management activities. Management of wilderness in the No Change

Alternative will be accomplished through existing wilderness management plans and current polices. Mitigation measures consist of a broad range of actions that avoid, minimize, rectify, reduce, or compensate for environmental effects.

If recreation use exceeds capacities, or the levels of acceptable environmental change established for any specific WRS class within a Wilderness, specific actions will be taken to reduce unacceptable use levels. These actions may consist of a permit systems, closure of specific areas with in Wilderness, access restrictions, and closures of roads or trails leading to points of entry. In addition, and as a prerequisite to other actions, user education and public contact can would be used to assist in the prevention of misuse and overuse of the Wilderness environment and related resource degradation. The establishment and monitoring of LAC factors for various elements of the Wilderness resource will aid in reducing effects on the environment. The LAC (U.S. Department of Agriculture--Forest Service 1985) process gives primary attention to acceptable existing Wilderness conditions and prescribing actions to protect or achieve those conditions. If the conditions are exceeded, action is taken to bring them into an acceptable range.

In areas that are characterized by concentrated use, mitigation measures will ensure maximum use and enjoyment within wilderness management standards. Typical areas of high use are arterial trail corridors, areas where major trails intersect, converge, or lead to places of high interest or destination, and staging areas or trailheads. Management Area 1a typifies this high use on 14,482 acres in Alternatives K and A. In this WRS class group sizes are larger; more groups will encounter each other; and, where they occur in this class, more campsites would be visible.

To maintain the essential character of Wilderness, group sizes, encounters with other parties, and intervisibility of campsites will be limited, and campfire sites will be designated if resource damage indicates a need. Dispersal of camps from each other and from attractive features within the Wilderness will reduce effects of concentrated use. To manage high intensity use and resource degradation camping may be prohibited in specific areas to facilitate recover of natural conditions (see Mitigation Measures under Vegetation). These and other measures may be found in the S & Gs included in the Forest Plan.

Although all prescribed burning in western Oregon will be scheduled for times when winds are expected to disperse smoke concentrations, smoke and haze may be evident in the airshed over or adjacent to Wilderness. The Clean Air Act and its 1977 Amendments mandate air quality and visibility protection for the Diamond Peak, Three Sisters, Mt. Washington and Mt. Jefferson Wildernesses. New Wildernesses established under the Oregon Wilderness Act of 1984, to date have not been redesignated visibility protected Class I Areas. Additional mitigation measures for reducing the impacts of prescribed burning on Wilderness air quality values include the scheduling of burning to avoid high Wilderness recreation use periods; increasing wood utilization on harvest units; and decreasing suspended particulate emissions production from slash burning (See also the discussion on Air in this Chapter).

During the past 40 to 50 years, fire suppression efforts have generally suppressed fires in the Wilderness at a smaller size than free-burning natural fires. Because of this change in the fire regime there has been some increase in forest residues, although the buildup has not generally reached a critical level in the western Cascades. Over time however, this may develop into a greater problem and larger, more intense wildfires could be expected in the future. The longer fire is kept out of these areas, the more the vegetation develops towards a climax seral stage with higher accumulations of natural dead and down material. Prescribed burning may be considered in Wilderness where necessary to perpetuate natural ecosystem succession without threatening public safety or adjacent nonwilderness lands. For additional information on prescribed burning and fire suppression in the Wilderness see Section 5, Fire.

Relationships with Other Agency Plans or Policies for Wilderness

Coordination with other agencies is an ongoing process to ensure that users and rights afforded them by the Wilderness Act are provided without impairment of Wilderness values. Examples include: the fish stocking program of Oregon Department of Fish and Wildlife (ODFW); taking mineral samples by the U.S. Geological Survey; and collecting water samples by the Environmental Protection Agency.

The Forest and the Confederated Tribes of the Warm Springs Indian Reservation are working together to resolve trespass issues on the Reservation which is bordered by the Mt. Jefferson Wilderness. Forest visitors and commercial users initiating day or overnight use may inadvertently cross the Forest boundary onto the Reservation and risk citation for trespass. Public information about management policy and regulations to Forest users in the Mt. Jefferson Wilderness will be a focus of the cooperative management effort.

Inadequate Information

Information regarding both the physical capacity of Wilderness resources to accommodate specific types of use and the factors relating to the social capacity specific to the Forests 8 Wildernesses, including the amount, duration, type, purpose and point of entry of Wilderness use is inadequate for the purposes of affective wilderness planning and management.

Environmental Consequences Of The Alternatives On Artifacts And Sites

Human use of land and resources now encompassed within the Forest boundary extends over a period estimated to be at least 8,000 years. The physical remains of prehistoric, Euro-American, and early Forest Service administrative use are documented throughout the Forest. Artifacts and sites include rock quarry sites, open lithic sites, rock shelters, religious sites, wagon roads, homesteads, mines, cabins, trails, administrative buildings and structures. These cultural resources are a unique, fragile, and nonrenewable feature of the environment and are recognized by a number of historic preservation laws, regulations, and policies. The probability of exposing or damaging artifacts and sites increases as lands are used in activities that modify the landscape.

Potential impacts to artifacts and sites are relative to the amount and location of ground disturbing activities proposed by the alternatives. All of the alternatives contain activities that reshape landforms or alter the vegetative cover of the landscape. Activities associated with timber harvest generally have the most widespread consequence to artifacts and sites throughout the Forest. Road construction, and building and site development, also have the potential to generate significant impacts, however on a more localized basis.

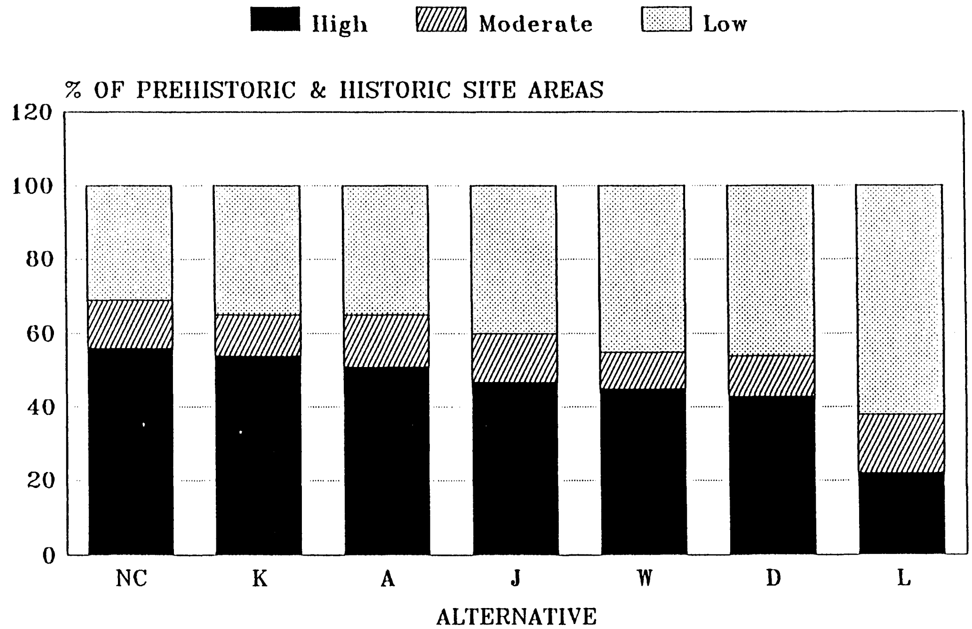
While ground disturbing events can damage artifacts or archeological sites, they also provide opportunities for identification of previously unknown cultural properties. In heavily vegetated environments, the removal of understory and forest duff may provide the only means of locating artifacts. Direct and indirect effects may be natural, project related, or the consequence of public use. Natural processes that affect artifacts and sites include weathering, insect infestation, erosion, moisture, tree fall, trampling by wildlife, and fire. Natural effects may increase in significance when coupled with the effects of human activities but may also generate additional opportunities for discovery and enhancement.

Direct and Indirect Effects of the Alternatives on Artifacts and Sites

The effects of the alternatives on cultural artifacts and sites is assessed for both known sites and for areas where the occurrence of sites is probable. To facilitate analysis of potential impacts, management areas are grouped into three categories of potential effect; high, moderate, and low. (See Figure IV-19 for an explanation of potential effect categories). The greater the number of known or potential sites or areas having frequent and extensive modifications of the environment (moderate to high effect), the greater the risk of adversely affecting artifacts and sites. Activities such as timber harvest and road construction have the most significant effect. Effects on artifacts and sites range from disturbance, destruction, or loss of part or all of the resource, to modification of the surroundings of a site such that its contextual integrity is destroyed.

Timber harvest activities are expected to have the greatest potential to damage artifacts and sites because of the extent of ground disturbance. Timber harvest activities will cause considerable disturbance to surface and subsurface soil profiles in localized areas, such as landings, skid trails, and within harvest units. The repeated use of heavy equipment in these areas to fell trees, and yard and pile logs can result in the disturbance, displacement, or crushing of cultural artifacts and sites.

Figure IV-19. Effects on Known Artifacts and Sites



	Alternatives [1]						
Level of Effects [1]	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
High	56	54	51	47	45	43	22
Moderate	13	11	14	13	10	11	16
Low	31	35	35	40	45	46	62
TOTAL	100	100	100	100	100	100	100

[1]Values are in percent of total prehistoric and historic site areas.
[2]**High** - High potential for major alteration of the environmental setting of significant sites; high potential for disturbance of currently unidentified sites. Opportunities for the identification of new sites, however, is also the greatest at this level.
Moderate - Moderate potential for alteration of the environmental setting of significant sites; motorized recreational use increases threats to unprotected sites; substantial opportunity for interaction of the public with cultural resources.
Low - Low potential for impact from land modifying activities; timber harvesting limited; motorized recreational use constrained; primary effect of wilderness management will be to standing structures, but overall these constitute a small proportion of the cultural resorces in the Wilderness. Less emphasis on identification of new sites; more opportunities for preservation of sites in place.

Road construction activities such as excavation, grading, and filling have the greatest potential to effect sites through ground disturbance. Roads tend to be located in areas where artifacts and sites are most frequently found, such as river valleys and terraces, topographic benches, and ridge systems. Because of the magnitude of disturbance, road construction is expected to have the potential to cause the greatest damage to artifacts and sites. However, cultural resource inventories conducted prior to proposed road construction also provide opportunities to locate previously unknown sites that would otherwise go un-discovered.

The magnitude of effect that each alternative has upon known sites and areas of probable occurrence is determined by the amount of coincidence each potential effect category has with the area of known cultural resource sites, and with each of three cultural resource occurrence frequency classes. Figures IV-19 and Table IV-36 illustrate the effect that each alternative has on artifacts and sites.

As illustrated in Figure IV-19 the potential effect on known prehistoric and historic sites and artifacts is variable among the alternatives. In Alternatives NC, K, A, and J, 60% to 69% of the area occupied by prehistoric and historic sites is within management areas that either have a high or moderate potential to effect cultural artifacts and sites. Alternative L is expected to have the least effect as only 38% of the known site areas is coincident with management areas having high or moderate potential to disturb, displace, or damage artifacts and sites. In Alternatives W (PA), and D 54-55% of the know site areas is coincident with management areas having high to moderate potential effects.

In addition to potential effects to known artifacts and sites, the alternatives have the potential to effect Forest areas where the frequency of sites ranges from high to low. Table IV-36 illustrates the effects of the alternatives on the site occurrence frequency areas of the Forest.

Table IV-36 Effects on Artifacts and Sites by Occurrence Frequency Class

		Alternatives [1]						
Occurrence Frequency Class	Level of Effect [2]	NC	K	A	J	W	D	L
High Frequency (393,254 ac.)	High	47	50	47	45	43	37	18
	Moderate	21	20	21	18	10	18	10
	Low	32	30	32	37	47	45	72
	Total	100	100	100	100	100	100	100
Moderate Frequency (133,675 ac.)	High	74	68	74	67	60	59	29
	Moderate	9	8	9	7	4	9	9
	Low	17	24	17	26	36	32	62
	Total	100	100	100	100	100	100	100
Low Frequency (1,246,590 ac.)	High	53	46	53	52	42	43	18
	Moderate	8	7	8	8	4	8	7
	Low	39	47	39	40	54	49	75
	Total	100	100	100	100	100	100	100

[1]Values are in percent of area.
[2]**High** - High potential for major alteration of the environmental setting of significant sites; high potential for disturbance of currently unidentified sites. Opportunities for the identification of new sites, however, is also the greatest at this level.
Moderate - Moderate potential for alteration of the environmental setting of significant sites; motorized recreational use increases threats to unprotected sites. Future management options are varied; substantial opportunity for interaction of the public with cultural resources.
Low - Low potential for impact from land modifying activities; timber harvesting not permitted; motorized recreational use constrained; primary effect of wilderness management will be to standing structures, but overall these constitute a small proportion of the cultural resorces in the Wilderness. Less emphasis on identification of new sites; more opportunities for preservation of sites in place.

The alternatives are clustered into three groups in respect to their consequences on areas having high and moderate occurrence of cultural sites. Group one, Alternative L allocates the smallest amount of these frequency classes to management areas having high and moderate effects, and thus minimizes potential, yet characteristic, effects from industrial forest operations. Group two, Alternatives NC, K, A, and J allocate the most area to uses with either high or moderate potential to effect cultural artifacts and sites. Group three, Alternatives D, and W (PA) in respect to area affected, allocates significant areas having high and moderate occurrence of cultural sites to management areas have high to moderate effects although less than Group two.

Assessments to predict accurately the consequences of the alternatives on cultural artifacts and sites is very limited since the actual number, location, and significance of all the cultural resources in the Forest is unknown. It is, however, useful to estimate potential consequences by quantifying the amount of ground disturbing activity generated by the alternatives. Actual impacts to cultural resources within any of the frequency classes will mainly be a result of timber harvest and road construction activity. These activities will occur in management areas having potentially high to moderate effects. Table IV-37 illustrates the predicted amount of ground disturbance due to timber harvest and miles of road construction that will occur in the high and moderate effect categories.

Table IV-37 illustrates the amount of Forest area to be harvested during the next five decades as well as the miles of new road to be constructed. The effect of these activities on known artifacts and sites, as well as areas of high and moderate frequency of site occurrence varies by alternative and by decade. It is evident from this information that effects beyond the second decade will result primarily from timber harvest activities rather than road construction. By the end of the fifth decade effects related to roads will be a consequence of road reconstruction.

Table IV-37. Expected Ground Disturbance on Artifacts and Sites [1]

	Alternatives						
Time Period	**NC [2]**	**K**	**A**	**J**	**W**	**D**	**L**
1st Decade							
M Acres	NA	125.7	120.6	101.8	91.0	98.9	33.1
Miles	NA	550	500	450	400	300	120
2nd Decade							
M Acres	NA	126.4	121.2	100.0	93.6	99.5	27.6
Miles	NA	90	130	70	70	50	40
3rd Decade							
M Acres	NA	116.7	112.5	83.1	80.5	83.0	21.9
Miles	NA	90	70	60	60	30	20
4th Decade							
M Acres	NA	105.3	99.7	87.1	80.7	83.4	28.9
Miles	NA	80	50	40	50	10	10
5th Decade							
M Acres	NA	118.1	115.7	82.0	81.3	85.1	23.2
Miles	NA	40	50	40	20	10	10

[1]Ground disturbance is from acres of timber harvest and miles of road construction.
[2]Data for the No Change Alternative is not available. However, acres harvested and miles of road to be constructed and related effects for this alternative are expected to be similar to Alternative K.

Cumulative Effects of the Alternatives on Artifacts and Sites

The artifacts and sites on the Forest are part of a rapidly diminishing, nonrenewable resource base. The combination of impacts from past landscape modifications, private development, vandalism, and natural deterioration have destroyed much of this record. The exact extent of the loss and the range of site types affected cannot be determined since there were no cultural resource inventories or records preceding most of these activities prior to about 1975. Thus there are few opportunities today to mitigate the cumulative effects of the past. Once destroyed, a cultural resource cannot be replaced. This points to the need for even more careful consideration of cultural resources in the future.

The existing cultural resource compliance process requires that the cumulative effects to cultural resources of any proposed action taking place on National Forest land be considered during project planning. Potential adverse effects can be avoided or mitigated through a variety of measures. Some impacts can be mitigated through scientific data recovery. However, data recovery (excavation) is inherently a destructive process, especially if it is spurred by the need to essentially "salvage" sites in advance of ground disturbing projects such as timber harvest. Data recovery plans address current research questions by using current theories and techniques. But such projects may also destroy data that would be needed in the future when new theories and techniques are developed, thus enhancing the value of remaining sites.

In addition, there is no adequate compensation for the physical loss of some sites. These are resources which, in part, are aesthetically significant and convey, by their existence in place, a special human link with the historic past. For example, the images evoked by the prehistoric carving on a rock outcrop or a rustic cabin are just as strong, and possibly stronger, in a young child as in a trained scholar. The cumulative effects of the various alternatives on these types of resources cannot be mitigated.

Mitigation Measures for Artifacts and Sites

Mitigation measures are specified in the S & Gs included in the Forest Plan and implemented through the Forest-wide cultural resource program. This program integrates inventory, evaluation, protection, and enhancement of cultural resource values into all Forest management activities of a ground disturbing nature.

An important step in the preservation and protection of artifacts and sites is a systematic inventory well in advance of Forest management activities. Prior to any ground disturbing activities the Forest will identify, evaluate, and mitigate impacts to all National Register eligible sites and artifacts that may be affected by a project. On a site specific basis, the ultimate decision whether to practice avoidance of a site or to carry out mitigation measures in lieu of avoidance will be based on both the nature and uniqueness of the cultural values at the site, and the costs of the desired mitigation measure. If excavation is determined to be the appropriate response, a Data Recovery Plan is prepared and implemented by professional archeologists in consultation with the State Historic Preservation Office and reviewed by the Advisory Council on Historic Preservation.

Proposed roads, trails, timber sale units, and other project boundaries can generally be adjusted without additional cost or inconvenience, if the need is determined during the early planning stages of the project. This eliminates effects or threats to cultural sites while encouraging "business as usual" with respect to other management activities. Frequently, activities may be carried out around a cultural site with minimal disturbance through creation of protective buffer zones, use of special technologies, or reduction of the actual area of ground disturbance.

Mitigation measures for cultural resources often include a combination of practices, particularly as they are applied to timber harvest operations. For example, when logs are yarded to a landing area the full suspension of logs substantially reduces or avoids disturbance to the ground surface. Full suspension, in combination with directional felling of trees away from the cultural site, and monitoring of the harvest activities by trained cultural resource technicians, can provide nearly full protection to the cultural resource site.

Where tractor logging is planned, the restriction of the overall number of skid trails and a designated system of trails are utilized to reduce effects. In previously harvested areas, existing skid trails are used wherever possible. The concept of designated skid trails has been successfully tested in soil compaction studies but the concept is likewise applicable to cultural resources (Froelich et al. 1981).

The use of a buffer between equipment and the ground surface may be suitable where there are no above ground structural remains. Recent studies on the Winema National Forest have tested the concept of logging over snow as an effective method of protecting cultural resources (Frances Philipek, personal communication). The results indicate some success as long as the soil characteristics, snow depth and moisture content, slope, and air temperature meet certain criteria. The location of the landings, the method of subsequent slash piling, and careful administration of the timber sale contract to see that specialized criteria are met, are crucial to the success of this technique.

On occasion it is impossible or economically unrealistic to avoid completely, a cultural site, particularly during road construction or reconstruction operations. Where there are no above ground structural features or remnants, crushed aggregate or other materials may be applied to protect the cultural site. The unavoidable loss of an historic cultural resource site can be mitigated by mapping, photo documentation or scaled drawing prior to project implementation. Normally, this documentation is done to the standards of the Historic American Building Survey (HABS) or the Historic American Engineering Record (HAER), whichever is applicable. This process is one of the more common measures preceding the removal of historic properties. In the case of linear features, such as historic ditches, wagon roads, highways, railroad grades, and so forth, a combination of thorough documentation of the feature with preservation of a designated segment may be acceptable.

In some cases, it may be appropriate to excavate archaeological resources. Specific criteria are considered including the significance of the property, the cost of data recovery and the scope of the project. Guidelines specified in the Forest Service Manual are followed and the excavation may be contracted out to a consulting archaeologist. Enhancement and interpretation of cultural sites present an opportunity for increased public education and awareness, although occasionally public use may result in the destruction of cultural properties because of vandalism, relic collecting, theft, and carelessness. Protective measures include directing public use away from sites, maintaining the confidentiality of specific prehistoric site locations, and periodic monitoring of sensitive areas.

Relationships With Other Agency Plans and Policies for Artifacts and Sites

Whenever a significant/eligible cultural resource site is located within the area of a projects potential environmental effect, the Forest Service must consult with the State Historic Preservation Office (SHPO) to determine whether the project will have an effect on the values of the site that qualify it for the National Register of Historic Places. If the project will affect the site, then the Advisory Council on Historic Preservation must be given the opportunity to comment on the project prior to its approval. This consultation process is defined in 36 CFR 800, and fulfills the requirements of Section 106 of the National Historic Preservation Act of 1966, as amended.

Consultation has and will continue to occur with the Confederated Tribes of the Warm Springs, Grand Ronde and Siletz, and the Cow Creek Band of the Umpqua. Consultation and coordination with Native American Tribes regarding the affected environment of the Willamette National Forest has resulted in a greater awareness of a American Indian cultural heritage, values, and issues. Consultation has focused on the site testing program with requests for information about areas of historical, traditional, and cultural use on the Forest. When a site of significance is discovered, Native American Tribes will be consulted and involved immediately. No burial sites have been located on the Forest to date.

Inadequate Information

Current inventories of cultural resources are incomplete regarding the number, location and significance of artifacts and sites in the Forest, thus, limiting through evaluation of potential effects of alternative Forest management proposals on cultural resources.

Environmental Consequences Of The Alternatives On Special Interest Areas, Old Growth Groves And National Natural Landmarks

There is currently one established Special Interest Area (SIA), Lamb Butte Scenic Area, 28 designated Old Growth Groves (OGGs), and no National Natural Landmarks (NNLs) in the Forest. The Forest inventory of potential Special Interest Areas shows 49 areas, totaling 36,960 acres that could be classified as cultural, zoological, geological, botanical, scenic, or recreation areas. A current inventory of OGGs includes 38 areas totaling 7,496 acres. The inventory of potential National Natural Landmarks includes 21 areas, totaling 39,652 acres, nearly half of which are preserved within Congressionally designated Wilderness.
Because these types of areas also provide recreation opportunities, they affect the capability of the Forest to meet present and projected demand for various types of dispersed or developed recreation settings. The designation of special, restricted use areas also affect the capability of the Forest to provide other recreational opportunities and services.

Areas that are designated under these three categories as a result of implementing one of the proposed alternatives will be managed either in a natural or developed condition where appropriate to accommodate access for use and enjoyment of individual areas. Generally, development areas will receive improvements for viewing and interpreting special features and resources.

Certain types of activities or developments adjacent to existing or within potential SIAs, OGGs, or NNLs sites could result in disturbance to the specific values to be protected, studied or enjoyed. In the remaining nonestablished areas, future designation may be precluded by resource development activities such as timber harvest or road construction, or natural events such as fire, flood, or overuse by wildlife.

Direct and Indirect Effects of the Alternatives on Special Interest Areas, Old Growth Groves and National Natural Landmarks

The most significant effect upon the potential SIAs, OGGs and NNLs is whether areas are preserved or not. For areas that are preserved only the incidental effects associated with recreation development, use, or natural processes are anticipated.

For areas allocated to uses that alter the conditions of individual areas or their surroundings, the values or features of interest would be potentially lost or impaired. The degree of loss or impairment is relative to the extent of development associated with each management area to which potential SIAs, OGGs or NNLs are allocated.

The disposition of potential SIAs, OGGs and NNLs in the alternatives is summarized in Tables IV-38, IV-39 and IV-40. As indicated by the figures below, Alternatives W (PA), D, and L would preserve the characteristics and values associated with 84% to 100% of the potential SIA acreage. In Alternatives NC, K, A, and J between 12% and 68% of the potential acres would be allocated to uses that preserve their special features or natural qualities. In Alternatives NC, K, and A, the characteristics and values of potential Special Interest Areas would be either impaired or lost on 32% to 88% of the inventoried acreage.

Lamb Butte, the only established Special Interest Area in the Forest, is subject to the influences of adjacent timber harvest and road construction along it's western boundary in Alternatives NC, K, A and J. However, adjacent activities would primarily affect scenic quality of the surrounding area rather than the physical resources of Lamb Butte. All other alternatives propose complementary forms of management in the area surrounding Lamb Butte Special Interest Area.

Table IV-38. Effects on Potential Special Interest Areas

	Alternatives						
Development Category [1]	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Low	12	24	27	68	93	84	100
Moderate	50	18	43	14	5	5	0
High	38	58	30	18	2	11	0
TOTAL	100	100	100	100	100	100	100

[1] Degree of effect associated with development category in percent of inventory acres:

Low = Preserves conditions and values.
Moderate = Activities may impair conditions or values.
High = Activities may result in the loss of conditions or values.

As indicated in Table IV-39, Alternatives J, W (PA), and L would preserve the characteristics and values associated with 70% to 95% of the potential OGG acreage. In Alternatives NC, K, A, and D between 30% and 66% of the potential acres would be allocated to uses that retain the special qualities and outstanding features of Old Growth Groves. In Alternatives NC, K, and A, the characteristics and values of potential Old Growth Groves would be either impaired or lost on 61% to 70% of the inventoried acreage.

Table IV-39. Effects on Potential Old Growth Groves

	Alternatives						
Development Category [1]	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Low	30	31	39	70	95	66	73
Moderate	17	11	17	7	0	4	19
High	53	58	44	23	5	30	8
TOTAL	100	100	100	100	100	100	100

[1] Degree of effect associated with development category in percent of inventory acres:

Low = Preserves conditions and values.
Moderate = Activities may impair conditions and values.
High = Activities may result in the loss of conditions and values.

The effects of the alternatives on potential NNLs as indicated in Table IV-40 include: preservation of between 91% and 100% of the inventoried area in Alternatives W (PA), D, and L, and the impairment or loss of NNL features and natural qualities in 27% to 34% of the inventoried areas in Alternatives NC, K, A, and J. There are no areas proposed by the alternatives for inclusion into the National Park Service National Natural Landmarks System. In Alternatives W, D, and L most all of the potential NNLs would be coincident with formally established research areas, Wilderness, Wild and Scenic Rivers, and areas proposed for designation as Special Interest Areas, Old Growth Groves, and semiprimitive recreation areas.

Table IV-40. Effects on Potential National Natural Landmarks

	Alternatives						
Development Category [1]	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Low	70	66	71	73	91	95	100
Moderate	22	25	22	24	4	3	0
High	8	9	7	3	5	2	0
TOTAL	100	100	100	100	100	100	100

[1] Degree of effect associated with development category in percent of inventory acres:

Low = Preserves conditions and values.
Moderate = Activities may impair conditions and values.
High = Activities may result in the loss of conditions and values.

Cumulative Effects on Special Interest Areas, Old Growth Groves and National Natural Landmarks

As natural settings are altered through timber harvest and road construction, the capacity of the Forest to provide some types of Special Interest Areas, Old Growth Groves and National Natural Landmark settings is diminished. This is particularly true of potential areas not designated as SIAs, OGGs or NNLs in any of the alternatives and whose attributes are not preserved by similarly protective management area allocations. The special features and attributes of these areas will likely be altered during the planning horizon through intensive Forest management activities. In addition, changes to vegetation patterns, surface drainage, and soil horizons on land adjacent to established SIAs, OGGs or NNLs, may over a period of time affect the natural processes of individual areas. Catastrophic events such as fire and flooding could destroy the values within both potential and designated Special Interest Areas, Old Growth Groves and National Natural Landmarks.

Mitigation Measures for Special Interest Areas, Old Growth Groves and National Natural Landmarks

Special Interest Areas, Old Growth Groves and National Natural Landmarks will be managed principally for public recreation use, study, and enjoyment. Recreational use is permitted when there is no conflict with protection of distinctive characteristics; use will be restricted only to the extent necessary to protect unusual features. Mitigation measures to reduce impacts from vandalism or overuse include public education, rehabilitation, displacing users into less utilized sites, and closing areas. Diseased or hazardous trees located in high use areas or along trails will be removed for the safety of Forest users.

Relationships with Other Agency Plans or Policies for Special Interest Areas, Old Growth Groves and National Natural Landmarks

The effects of implementing any of the alternatives are not expected to conflict with current objectives of State and local planners. Agencies such as the State Oregon Division of Parks and Recreation and the State Historic Preservation Office are consulted regarding the management of areas such as SIAs, OGGs and NNLs. The State Tourism Council is pursuing destination point features in Oregon. As interest among public agencies and private entrepreneurs in developing the State's tourist industry increases, there may be a consequent increase in interest in establishing SIAs, OGGs and NNLs as visitor destination points.

Incomplete or Unavailable Information

Assessments of resource capacity of individual areas to accommodate recreation use and related activites without impairment of special values or features.

Environmental Consequences Of The Alternatives On Research Natural Areas And The H.J. Andrews Experimental Forest

As land use and resource utilization intensify, the need for research involving the climatic, geologic, and biologic systems of the forest environment is expected to become greater. With the ever greater demand for the various uses of land, both public and private, more knowledge is necessary to protect and keep these lands productive. On the Forest, areas have been selected and/or proposed as Research Natural Areas which are representative of cells (habitats, communities, organisms, etc.) deemed important elements in the Pacific Northwest coniferous biome.

Research Natural Areas supply ecological reference points and provide experimental controls for assessing the results of activities in managed areas of the Forest. The four Research Natural Areas are currently used to preserve a representative natural situations including the subalpine mountain meadows, subalpine bogs, noble fir stands on mountain ridges, and old-growth Douglas-fir/western hemlock forests of the Western Cascades. These areas are also used by amateur botanists and biologists, and academic institutions.

Popular Research Natural Areas are vulnerable to disturbance as a result of vegetative trampling or removal of specimens. In addition to the four existing Research Natural Areas, five additional areas have been identified as potential RNAs. If these areas are allocated to other uses, future opportunities to establish these areas as RNAs may be limited or forgone. (See Chapter III, Research Natural Areas and H.J. Andrews Experimental Forest for detailed descriptions of these areas.)

While there are no additional Experimental Forests proposed for the Forest, the management of the H.J. Andrews Experimental Forest (HJA) will continue to meet specific research needs through a joint effort of the Pacific Northwest Forest and Range Experiment Station and the Forest. Research in the HJA focuses on the ecology and management of coniferous forests and watersheds in the Douglas-fir region. Projects have studied the effects of timber harvest and roads upon land stability, site productivity, sediment yields, and water quantity and quality within the old-growth Douglas-fir forest environment, old-growth, and eco-system functioning.

Direct and Indirect Effects of the Alternatives on Research Natural Areas and H.J. Andrews Experimental Forest

The research activities in the H.J. Andrews Experimental Forest (HJA) are often designed specifically to alter vegetation, landform, wildlife habitat, soil or water. In this respect, timber harvest and road building activities are induced for the purpose of study and research. These induced effects may be viewed as adverse in an environmental sense although they are desired and essential in a research context.

In addition to changes that may result from research purposes, minor changes in conditions are expected a consequence of natural events such as wind, fire, insect, and disease within the HJA and RNAs. Extensive timber harvest on the perimeter of these areas could reduce the effective size of some of the included habitats.

The Spotted Owl Habitat Areas located in the HJA could restrict some of the activities necessary for conducting research in all alternatives, except the NC Alternative.

As a consequence of implementing any of the proposed alternatives there would be impacts to potential RNAs. The location and magnitude of these effects are relative to the number of areas allocated as RNAs in each alternative and the disposition of the remaining areas not allocated as RNAs.

Table IV-41 illustrates the acreages of individual RNAs provided in each alternative.

Table IV-41. Research Natural Area Acreage

	Alternatives						
Area Name	**NC**	**K**	**A**	**J**	**W**	**D**	**L**
Middle Santiam [1]	1,152	1,152	1,152	1,152	1,152	1,152	1,152
Three Creeks	--	--	--	512	725	--	--
Wildcat Mountain	1,003	1,003	1,003	1,003	1,387	1,003	1,003
McKenzie Pass [1]	--	--	--	1,088	1,130	1,088	--
Hagan Block	853	--	853	1,280	1,280	1,280	--
Olallie Ridge	725	725	725	725	725	725	725
Torrey-Charlton [1]	2,048	2,133	2,048	2,112	2,133	2,133	--
Gold Lake Bog	469	469	469	469	469	469	469
Rigdon Point	--	--	--	427	469	427	--
TOTALS	6,250	5,482	6,250	8,768	9,470	8,277	3,349

[1] RNAs that are wholly or partially within established Wilderness.

Table IV-42 displays the distribution of acreages of established and potential RNAs by development categories for each alternative.

The effects on potential RNAs allocated to other than RNA uses is based upon whether the allocated uses would result in no development, limited development, or full development of inventoried areas. Allocation of areas to full or limited development would preclude their use for baseline studies of undisturbed environments.

Table IV-42. Effects on Research Natural Areas

	Alternatives						
Development Categories	**NC [2]**	**K**	**A**	**J**	**W**	**D**	**L**
No Development	79	69	79	94	100	96	94
Limited Development	7	1	7	2	0	0	1
Full Development	14	30	14	4	0	4	5
TOTAL	100	100	100	100	100	100	100

[1]Includes Middle Santiam RNA within the Middle Santiam Wilderness, the western portion of the Torrey-Charlton RNA within Waldo Lake Wilderness, and a portion of the McKenzie Pass RNA within the Three Sisters Wilderness.

[2]Values are in percent of total acres of potential and established RNAs.

Many of the RNAs provided by the alternatives are surrounded by proposed uses that buffer or otherwise limit effects from the use or management of adjacent lands. All but two RNAs in Alternatives NC, A, and J; four in Alternatives K and W (PA); three in Alternative D; and one in Alternative L are surrounded by uses that buffer or otherwise limit effects from adjacent management activities. Several un-buffered RNAs would be subject to the potential effects of adjacent management such as timber harvest and road construction on adjacent lands.

In some of the alternatives, research potential woull be lost due to development of some areas for resource utilization activities, such as road construction and timber harvest. In Alternatives NC, K, and A, between 21% and 31% of the potential RNA acreage is proposed for resource development. Alternatives J, W (PA), D and L would retain between 94% and 100% of the Forest's inventoried RNA potential in an undisturbed condition.

Cumulative Effects of the Alternative on Research Natural Areas and H.J. Andrews Experimental Forest

The nondesignation of areas as RNAs and subsequent alteration of their conditions over a period of time would result in an eventual loss of research potential. Losses, over time, because of nondesignation would be relative to each areas research potential as described in Chapter III.

Mitigation Measures for Research Natural Areas and H.J. Andrews Experimental Forest

The primary form of mitigation of undesirable effects is boundary identification of individual areas. Areas are generally defined as "closed systems" such as a complete subdrainage or ridge top to avoid contributions of effects such as displaced soil or water runoff from adjacent areas.

In some instances, the intensity of activities on adjacent land is expected to be modified to protect values within the research areas. In the case of RNAs, the establishment report, prepared for each area, sets forth an area objective of maintaining the ecosystems within the boundaries in a natural state of succession.

Other measures include the prohibition of timber harvest, transportation, and utility corridors; withdrawal from mining and mineral leasing; the discouragement of recreation use; and erecting barriers such as fences to exclude domestic stock if necessary. Trails necessary for research projects will be constructed, reconstructed, and/or maintained to the minimum standard required for projects and to provide basic resource protection.

Relationships With Other Agency Plans or Policies for Research Natural Areas and H.J. Andrews Experimental Forest

The HJA is managed according to an Intra-Agency Agreement with the PNW F&RES. Periodic local site committee meetings are held with the PNW, the Forest, and OSU and other interested scientists to plan and discuss on-going research and administrative activities

There are no conflicts between the effects of the alternatives on the Experimental Forest and established Research Natural Areas and the plans of others agencies. There are no conflicts with management of lands of other ownerships and the H.J. Andrews Experimental Forest or established and proposed

Research Natural Areas. A conflict could arise with the Research Natural Area committee if a potential RNA in the Forest is the only area that could fill a research cell need, and is not proposed for establishment.

Incomplete or Unavailable Information

An inventory of existing conditions of proposed RNAs as affected by historic use and natural events.

Environmental Consequences Of The Alternatives On Transportation Systems

The Forest has a developed road transportation system that allows the flow of timber and minerals to local communities. The transportation system also allows access to major portions of the Forest for timber harvest, hunting, fishing, sight seeing, and numerous other activities. Management of resources and programs effects the existing transportation system and determines the need for further development, maintenance, reconstruction and use of roads.

Direct and Indirect Effects of the Alternatives on the Transportation System

Soil and Geology - Soil properties, rock properties, and topography have direct effects on transportation (road) facilities. Availability, location, design, construction, maintenance, reconstruction, and cost of roads are effected by the geological characteristics of the Forest.

The existing Forest development road system is effected similarly in allalternatives. A portion of the road system is on stable soil and rock subgrades. The affect of the stable soil and rock subgrade on the road system is a generally stable road with few, if any, mass movement failures. Other portions of the road system are on moderately stable, unstable, or very unstable soil and/or rock subgrades. The natural effects on roads of the less stable soils/rocks is an increased incidence of road failure and an increased need for road maintenance. Mass soil movements could result in loss of roadbeds. The frequency of roadbed failure would be higher on less stable soils, especially where sideslopes exceed 50%. Loss of roadbed restricts or prohibits the availability of access, either through restriction of road width, or complete loss of the road in the area of mass soil movement. Road reconstruction is required more frequently, and it is more costly on unstable soils. Road maintenance is also more costly on less stable soils.

Road surfaces are typically constructed and surfaced with local rock materials. The quality of rock on the Forest varies widely by locality and geology. Roads surfaces in areas of volcanic breccias and tuffs, generally, are easily degraded by traffic and weather. In order to provide a serviceable road for timber harvest, road surfaces constructed of volcanic breccias and tuffs usually require a greater depth than those made from andesites and basalt materials. The additional depth of surfacing increases the cost over the average cost of constructing new roads. The rapid degradation of breccias and tuffs also requires frequent addition of rock to maintain adequate surface standards. The structural strength of breccias and tuffs is less than that of the andesites and basalts, and could result in a road surface that is driveable during only summer months. All alternatives propose roads in areas of andesite and basalt as well as breccias and tuffs. The alternatives proposing the most road miles, Alternatives NC, K, and A will have the highest proportion of new roads of the adesite and basalt materials. Alternatives J, W, and D will have an approximately like proportion of new road in breccias/tuffs and andesite and basalts. Alternative L will have the largest proportion of new road surfaces of the breccias and tuffs.

New roads would be effected by the soil, rock, and topography that the roads are located on. The significance of the effects are proportional to the number of miles constructed in each alternative. Alternatives with the highest number of new road miles will have the highest number and highest percent of new road miles on unstable and very unstable soils. The natural occurance of mass movements impacting roads will be highest for Alternatives K, A, and NC. Mass soil movements effecting new roads will occur at moderate intervals for Alternatives J, W, and D. In Alternative L the occurance of mass soil movements effecting new roads will be lowest in total numbers, but not necessarily in number of occurances per mile of road. A moderate number of occurances is expected in Alternative L.

Timber - Timber management would have direct and indirect effects on the existing road system and on new roads in all alternatives.

Timber harvest creates a demand for low standard roads to gain access to timber harvest sites and to haul timber from the harvest sites off the Forest. Most road construction on the Forest is in response to timber access needs. The alternatives with the highest allowable sale quantities, require the greatest number of miles of new low standard road construction.

Timber haul has physical direct effects on roads. Repeated truck trips create wear on road surfaces, and can lead to the eventual failure or a need to reconstruct road surfaces. Alternatives NC, K, and A result in the highest rate of wear on the highest number of miles of road. Alternatives J, W, and D create an amount of haul volume that is less than has been produced during the last few years. The haul volumes in Alternatives J, W, and D will produce a moderate rate of wear on a majority of the road system. Alternative L will create a lower amount of timber haul volume than the other alternatives. The rate of wear on road surfaces due to timber haul under Alternative L will be low to moderate and will occur on fewer miles of road than for the other alternatives.

Timber haul also has indirect effects on roads in the Forest. Alternatives that produce the greatest quantities of timber haul, also create the largest amounts of cooperative road maintenance funds which are collected from timber purchasers to be used on Forest roads. Therefore, under alternatives with high haul volumes (NC, K, and A) more funds are available for road maintenance. This results in a higher percentage of road miles being adequately maintained to the required standards. Alternatives J, W, and D produce less cooperative road maintenance funds than have been historically collected. This would result in increased need for congressional budget funds for maintaining roads at historic levles. Reduced haul over roads could reduce the need for maintenance or result in reduced road maintenance or limited access in some areas if no replacement funds are provided. Alternative L would result in a greater proportion of the road system being closed to travel, and reduced maintenance on the remaining road mileage.

Recreation - Recreation use on the Forest creates demand for roads to accomodate public travel. The type of recreation use creates different kinds of affects on the road system. Higher recreation volumes create a demand, generally, for higher standard roads(two lane or wide single lane, higher travel speeds, open to public travel, smoother roadway surfaces, greater visibility, etc.)

Driving for pleasure creates the highest demand of any recreation use for roads open to public travel. Alternatives NC, K, A, J, and W create the highest amounts of dispersed recreation, a portion of which, is associated with driving for pleasure. Demand for roads open for public use creates safety concerns and results in a need for higher standard roads that are well maintained. Alternatives D and L will produce the lowest demands for driving for pleasure experiences, and therefore, create fewer needs for safety, roads open to the public, or higher constructed and maintained standards.

Developed recreation creates demands for higher standard roads to and in develped recreation sites. Alternatives J, W, and D create new developed recreation sites and will require a small number of new miles of high standard road construction associated with these sites. Traffic generated by these new sites would add to the traffic volume on roads leading to developed sites from major highways. Safety concerns would increase on these roads and could increase the need for reconstruction on some roads.

Hunting use has a varying effects on roads. Hunting increases the amount of travel on the road system during a portion of the year. However, public demand for a quality hunting experience, especially elk hunters, requires that some roads be closed to motor vehicle travel during the hunting season.

Wildlife - Management requirements for management indicator species including bald eagles, peregrine falcon, northern spotted owl, pileated woodpecker, Roosevelt elk, and marten could have direct affects on the road system. Protection of these species often requires that roads be closed during certain seasons of the year, may prohibit new road construction, or limit the season of other types of road activity. Alternatives D and L protects the most acres of bald eagle, spotted owl, marten, Rooosevelt elk and pileated woodpecker habitat. These Alternatives would have the potential to prohibit or restrict the most road activities. Alternative W protects somewhat less acres of habitat, therefore would prohibit somewhat fewer road activities. Alternatives NC, K, A, and J have the least potential of effecting use or construction of roads.

Cumulative Effects of the Alternatives on the Transportation System

Soils and Geology - Over time the cumulative affects of soils and geology on roads are similar to their direct and indirect affects. Mass movements will continue to occur on road locations as a result of natural instability of the landscape. Sometimes these mass movements will cumulatively neccessitate reconstruction or relocation of a road facility. Often, though, maintenance will continue to be adequate in providing the needed road facility over time. Road surfacing continues to break down over time, and is lost through erosion processes. Cumulatively road surfacing composed of breccias and tuffs will need frequent replacement, and may neccessitate other types of road surfacing when these are cost effective.

Timber - Timber harvest and haul cumulatively affect the road system. Alternatives producing the highest timber harvests will have the greatest need during the planning horizon for an extensive and well maintained road system. Alternative L producing the least timber harvest and haul volume will have the least need during the planning horizon for an extensive and well maintained road system. over time, Alternative L, will have the affect of lowering the maintenance requirements, closing more roads, keeping more roads in a minimum level maintenance category, and may result more miles being removed from the transportation system than other alternatives.

Recreation - Recreation is projected to increase over time on the Forest. Cumulatively, recreation needs, especially driving for pleasure, and developed recreation, will require a certain number of roads constructed and maintained to a high standard over time.

Wildlife - Cumulative affects of wildlife over time on roads are that certain areas of the Forest will continue to prohibit roads, thus restricting access. Hunting pressures will continue to increase, and may have the result of more roads being closed to motor vehicle travel in future decades than is planned in the first decade. This affect, however, is not known with any certainty.

Mitigation Measures for the Transportation System

Standards and Guidelines represent mitigating measures for the transportation system. Design and construction methods incorporating sound geotechnical practice partially mitigate that affects of soil and geology on roads. Slope stabilization, retaining walls, locations avoiding known areas of instability, geotechnical investigation, and surface stabalization measures are all examples of mitigating measures currently being used on the Forest, and that will continue to be used for any of the alternatives.

Relationships with Other Agency Plans or Policies for Transportation Systems

Cooperative agreements and Memorandums of Understanding with Bureau of Land Management, State of Oregon, counties, and private concerning roads will need to be considered in the implementation of the Forest Plan. State agency direction concerning elk management will affect road closures. The Forest borders other National Forests; cross haul occurs from timber harvest on these forests and shall be considered in the location, design, construction, maintenance, and management of roads. Any potential reconstruction of the Waldo Lake Road will entail cooperation with the Deshutes National Forest.

Incomplete or Unavailable Information

Traffic data on the Forest is incomplete. Selected roads have had traffic surveilance data generated. Most data is at least three to four years old.

Effects of elk management on roads is insufficient at this time. Long-term research is currently being conducted in Eastern Oregon that may provide sufficient bases for road management.

Environmental Consequences Of The Alternatives On Minerals and Energy

Regulation of mineral and energy activities on the Forest is shared with the Bureau of Land Management (BLM). The demand for access to Forest lands for the purpose of mineral and energy exploration and development is expected to increase over the long term. Requests for access will be processed in a timely manner as prescribed by applicable laws, regulations, and policies.

Implementation of management activities requires the expenditure of energy. The amount of energy used varies by alternative although it is not possible at this time to quantify the energy requirements.

Direct and Indirect Effects of the Alternatives on Minerals and Energy

Land allocations and access development vary by alternative. Alternatives with more restrictive land allocations would place higher emphasis on the protection of scenic values, dispersed recreation values, water quality, special and unique habitats, wildlife habitat. Access would be less developed in alternatives emphasizing these values because lands available for timber harvest would be reduced.

Opportunities for exploration and development of minerals and energy would be greatest in Alternatives NC, A, K, and J, respectively. Alternatives W, D, and L, respectively would place increasing emphasis on scenic values, wildlife habitat protection, recreation, water quality, and other nonconsumptive resource values and would result in decreasing opportunity for mineral and energy development.

Direct and indirect energy requirements would be affected by all alternatives.
Direct energy requirements would include those required for timber harvest, road construction and maintenance, and administrative travel. Alternatives would require energy expenditure in proportion to the timber harvest levels and intensity of timber management. Indirect energy requirements include processing wood products and transport of products to mills and consumers. The energy requirements for the alternatives, ranked in order of increasing requirements would be NC, K, A, J, W, D, and L.

Cumulative Effects on Minerals and Energy

As mineral and energy development occurs, there would be a decrease in the availability of area open for exploration. The removal of minerals from the Forest depends on demand. Alternative L would have the highest potential to restrict mineral and energy development over the long term followed by Alternatives D, W, J, A, K, and NC, respectively. These effects would be caused by management areas prohibiting or highly restricting development and access.

The use of energy to implement the alternatives increases over time all Alternatives except L. The increased energy requirements result from the need to access steep, rough terrain, use increasingly complex timber harvest systems, and intensive timber management practices such as pre-commercial and commercial thinning, control and management of competing vegetation, application of fertilizers, and increased mitigation or enhancement activities needed to maintain water quality, fish habitat, wildlife habitat, and recreation facilities.

Mitigation Measures for Minerals and Energy

Forest-wide standards and guidelines (S&Gs) and management area S&Gs have been developed to provide direction for mineral and energy exploration, development, extraction, and rehabilitation.

Relationships With Other Agency Plans or Policies for Minerals and Energy

U.S. Department of Agriculture, Forest Service recommendations to the BLM regarding the availability of lands for mineral leasing are based on whether development activities could be implemented on Forest lands and meet the management requirements of the Forest Plan. Every application for leasable minerals requires site specific review of environmental effects. Standards and special permit stipulations are used to direct project activities.

Regulation of mining and drilling administered by the Department of Geology and Mineral Industries (ORS Chapters 516,517, and 520). Activities permitted on the Forest will be conducted in compliance with established rules.

Fill and removal operations conducted by the Forest will meet permit requirements of the Division of State Lands (ORS Chapters 274, 517, and 541).

RELATIONSHIP BETWEEN LOCAL SHORT-TERM USES OF THE ENVIRONMENT AND LONG-TERM PRODUCTIVITY

This Section addresses the effects of the Preferred Alternative (W) on long-term productivity. Forest resource management is a long-term venture and maintaining or maintaining the capacity of the land to provide resource outputs is a primary long-term objective. Short-term uses affect quality of life for the public. Primary examples on this Forest are timber harvest and recreation. The relationship between the short-term uses in the Preferred Alternative (W) and the long-term productivity of the Forest are discussed below.

Long-term productivity changes as a result of various management practices on the Forest. Forest management practices will have direct, indirect, and cumulative effects on the economic, social, and biological environment.

Soil and water are two key factors in ecosystem productivity, and these resources will be protected to avoid damage which could take many decades to rectify.

Wood fiber production will be increased as some of the older stands are harvested and converted to faster growing second growth stands. Timber rotations are normally over 80 years and are managed for long term sustained yield capacity. Silvicultural practices such as the use of commercial tree thinning will also generate measurable long-term gains in wood fiber production.

Opportunities for dispersed recreation use, including hiking, camping, fishing, hunting, snowmobiling, sightseeing and cross-country skiing will be maintained and increased for future generations. Activities planned on the Forest change the setting these activities occur in, but will not reduce the long term potential of the Forest to provide recreation opportunities.

The management of fish and wildlife habitat is designed to maintain viable, well distributed populations of existing native and desired non-native vertebrate species throughout the Forest planning area. The abundance and diversity wildlife species depends on the quality, quantity, and distribution of habitat, whether used for breeding, feeding, or resting. Seven individual species of birds and mammals, one group of birds, and two groups of fish have been selected as management indicator species (MIS). MIS are used to represent the habitat requirements of all fish and wildlife species found on the Forest. By managing habitats and populations of indicator species, the other species associated with the same habitat will also benefit. The Preferred Alternative (W) provides additional emphasis on maintaining long term habitat diversity by protecting special and unique habitats associated with riparian areas, marshes, bogs, meadows, talus slopes, and cliffs.

While some forest management practices reduce long term productivity by causing soil erosion or loss of habitat critical to fish and wildlife species, the desired future condition of the Forest is to maintain integrated ecological functions. For example, timber management activities such as clearcutting, roading, and prescribed burning alter the natural appearing landscape and have adverse impacts on the water quality, soil productivity, and interior forest habitat values. These impacts will be reduced by riparian protection standards, use of Best Management Practices for road construction, retention of snags and large down woody material in harvest units, and protection of large tracts of older forest habitat distributed within the managed forest landscape. In visual corridors, long-term effects of management activities will be avoided or mitigated to meet landscape management objectives.

The Preferred Alternative (W) provides management direction for the Forest for the next ten years. The management area prescriptions and standards and guidelines (S&Gs) specified in the Forest Plan are designed to ensure long-term productivity. These S&Gs will be monitored to ensure that long-term productivity of the Forest ecosystems will be maintained or improved. Details of the monitoring program are found in Chapter IV of the Forest Plan.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

This Section addresses the irreversible and irretrievable commitments of resources which would be involved in the Preferred Alternative (W).

An "irreversible loss of resources" results from a decision to use or modify non-renewable resources such as cultural resources or minerals, or resources that are renewable only over a long period of time. Measures to protect natural resources that could be irreversibly affected by management practices are incorporated in Forest-wide S&Gs of the Final Forest Plan and in the mitigation measures discussed in Chapter IV of the FEIS.

The irreversible disturbance of some types of cultural artifacts and sites is likely as a consequence of management activities. This would be especially true for subsurface sites that cannot be located through surface surveys. Even with mitigation, unanticipated or unavoidable disturbances can result in the loss of cultural values.

The removal of mineral or energy resources is an irreversible loss of resources. The utilization of rock resources for road construction would be an example. Actual commitment of mineral resources on the Forest will depend upon demand and mining industry exploration and development proposals.

In unroaded areas, development activities such as timber harvesting and road construction associated with harvest, recreation, or other purposes, will irreversibly reduce the potential amount of area that could be designated as a part of the National Wilderness Preservation System, managed as a Research Natural Area, or managed for other purposes requiring natural characteristics.

An irreversible loss also occurs when stands of old-growth and mature timber are harvested or removed for the construction of roads, campgrounds, ski runs, or other purposes. Old-growth stands provide key wildlife habitat and are also valued for ecological and esthetic reasons. Because old-growth stands take over 200 years to develop, the commitment of this resource to certain uses is reversible only over a long period of time.

High intensity fires can also cause irreversible losses to soil productivity by causing loss of soil structure, volatilization of nutrients, and accelerated soil erosion.

An irretrievable commitment of resources is a use of resources that is lost because of land management objectives. This represents opportunities foregone for the time that the resource cannot be used. Under multiple-use management some irretrievable commitments of resources are unavoidable due to the mutually exclusive relationship between some resources.

An irretrievable commitment of resources is the loss of timber management opportunities within designated Wilderness or other areas where timber production is prohibited or restricted. Another is the loss interior, old growth forest habitat where the management objective for an area is maximizing wood fiber production.

Some long-term uses of the land cause an irretrievable loss of soil productivity. Examples of these uses include the establishment of arterial and collector roads, administrative sites, and/or developed recreation sites.

PROBABLE ADVERSE ENVIRONMENTAL EFFECTS WHICH CANNOT BE AVOIDED

Implementation of the Preferred Alternative (W) on the Forest will result in some adverse environmental effects which cannot be avoided. The application of the management prescription (S&Gs) is intended to limit the extent and duration of these effects. Mitigation is reflected in the management prescriptions and mitigation measures are discussed within each section in Chapter IV of this document. Although the formulation of the Preferred Alternative (W) included avoidance of potential adverse environmental effects, some adverse impacts to the environment which cannot be completely mitigated are expected to occur.

Some adverse effects are of a transitory type. For example, air quality will diminish on a recurring though temporary basis, due to the use of prescribed fire. Most significant impacts will be from burning of debris resulting from timber harvest. Even though S&Gs require prescribed burning to be scheduled for times when weather conditions will provide for smoke dispersion, the presence of smoke and haze over or adjacent to the Forest will detract from people's expectation of clean air. Timber hauling and recreation traffic on untreated roads, and the operation of internal combustion engines, will have localized and temporary adverse effects on air quality where these activities occur.

The natural landscape will appear altered by timber harvest, particularly where logging activity is highly visible from travel routes. Burning of harvest units, and their blackened appearance will also be apparent. These adverse effects will eventually be reduced by growth of vegetation. Other impacts on the natural appearance of the landscape include roads and structures which are highly visible despite efforts to blend them with land forms and mitigate the effect by landscaping.

In unroaded areas, development activities such as timber harvesting, and road construction associated with harvest, recreation, or other purposes will have an adverse effect on the potential future management of these areas as designated Wilderness, as Research Natural Areas, or for other purposes requiring natural characteristics.

Disturbance, displacement, or loss of fish and wildlife may occur as a consequence of habitat loss and increased human activity in project areas. Roads and their associated use impact fish and wildlife due to human activities associated with new access into areas previously unroaded. Improved access into areas that previously had low standard roads would have similar effects.

Both the amount and distribution of mature and old-growth stands will be reduced through implementation of the Preferred Alternative (W). Since some wildlife species rely on habitat conditions provided by old-growth stands, a reduction in the populations of some wildlife species can be expected. As old-growth and mature timber stands are converted to young conifer plantations, the capability of the Forest to provide optimal cover for deer and elk will be reduced.

Ground disturbing activities will temporarily increase silt loads in some streams. This could displace fish, reduce anadromous and resident fish reproductive success, and alter aquatic invertebrate populations. In addition, a loss of fish habitat will occur at road crossings of streams. The portion of a stream bed occupied by a culvert or other structures will be lost as fish habitat.

Mineral and energy development may have unavoidable adverse effects on other resources. The scope of these impacts depends upon the location and type of activity proposed by industry. The approving of operating plans for locatable minerals and requiring surface resource stipulations for leasable minerals, will assist in the management and mitigation of these activities.

Fire hazard and resistance to control will increase subsequent to timber harvest and thinning operations as a result of increased accumulations of forest residues. Wildfire risk will increase where access results in more people using an area during and after management activities. Some of this risk will be mitigated by early detection, suppression, and prevention programs. Long-term increases in fuel hazard will be mitigated through fuels management activities that are responsive to resource management objectives.

Adverse effects will result from increasing recreation use and intensive Forest management activities such as timber harvest, road construction and maintenance, developed recreation, and development of other facilities. These adverse effects include disturbance to native vegetation; soil compaction; reduced water quality; increases in noise levels; disturbance to wildlife populations and their habitat; air pollution from campfire smoke, prescribed fire, and vehicle exhaust; and increased potential for human conflict.